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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper No. 8

THE MINING INDUSTRY

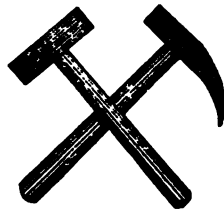
IN

NORTH CAROLINA DURING 1903

BY

JOSEPH HYDE PRATT, PH. D.

MINERALOGIST



RALEIGH

E. M. UZZELL & Co., PUBLIC PRINTERS AND BINDERS

1904



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GOVERNOR C. B. AYCOCK, *ex officio* Chairman.....Raleigh.
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I. A. HOLMES, State Geologist.....Chapel Hill.



LETTER OF TRANSMITTAL.

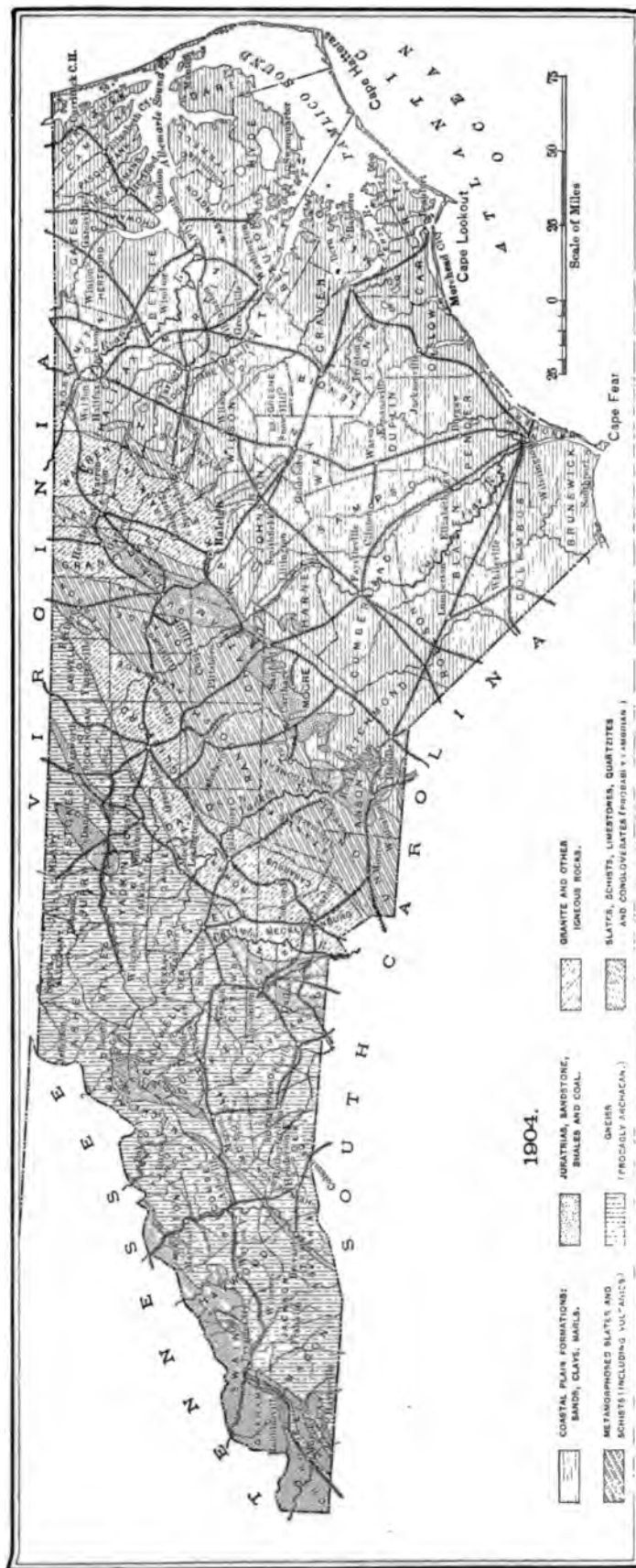
RALEIGH, N. C., May 1, 1904.

To His Excellency, HON. C. B. AYCOCK,
Governor of North Carolina.

SIR:—As the eighth of the series of Economic Papers, I have the honor to submit for publication a report on the *Mining Industry* in North Carolina for 1903. This publication takes up the statistics of the production of the various minerals that were mined in the State during 1903, and gives in detail descriptions of the occurrences of those mineral deposits of economic importance that have not been previously discussed.

Yours obediently,

J. A. HOLMES,
State Geologist.



MAP OF NORTH CAROLINA SHOWING THE DISTRIBUTION OF THE PRINCIPAL GEOLOGICAL FORMATIONS.

MINING INDUSTRY IN NORTH CAROLINA DURING 1903.

By JOSEPH HYDE PRATT.

INTRODUCTION.

The mineral production of North Carolina during 1903 was somewhat smaller than that of 1902, although there was a decidedly progressive and substantial development of the mineral properties in the State. This is shown more especially in the development of the gold and copper properties, many of which, though not producing any metal in 1903, are in a condition to become producers during 1904. There was a decided increase in the production of iron ores, but a falling off in the production of talc and kaolin; not due, however, to the lack of demand for these latter two minerals, but to the scarcity of the supply.

There has been a continual increase in the quantity and value of the production of clay products for a number of years and during 1903 there was a considerable increase in this production. Thus, at the present time, the total value of the production of clay products and kaolin is practically one-half of the total mineral production of the State.

The deposits that are attracting perhaps more attention than any other are the gold ores of the State; and, while there was some increase in the production of gold in 1903 over that of 1902, it may be confidently expected from the amount of systematic development work that has been carried on during the past year that there will be a much larger increase in the value of the production during 1904. This work has been applied largely to the development and re-opening of old deposits.

Another metal that is attracting considerable attention is tin, and the deposits of cassiterite, the ore of tin, in Gaston County are being prospected and developed very vigorously.

The aggregate value of the mineral production in North Carolina during 1903 was \$1,902,485 as compared with \$2,003,077, the value of the total production in 1902, which is a decrease of \$100,592. As compared with the value of the production of 1901, which was \$1,779,109, this is an increase of \$123,376. The minerals and ores that have been mined and have added to the production of mineral products in North Carolina in 1903 are given below in the order in which they are discussed in the following pages: Gold and Silver, Copper, Iron, Corundum, Garnet, Millstones, Mica, Quartz, Barytes, Monazite, Talc and Pyrophyllite, Precious Stones, Rare Earth Minerals, Graphite, Coal, Stone, Kaolin and Clay Products.

GOLD AND SILVER.

The area in North Carolina in which gold and silver deposits are known to occur embraces from 8,000 to 10,000 square miles of the middle and western counties. In this area there are over 400 localities in the State that have been mined for gold and silver. In 1903 there were 31 counties that added to the production of these metals. In some the gold was obtained as a by-product in placer mining for other minerals, such as monazite, and in other cases was obtained in development work or prospecting and amounted to but a few ounces of these metals. There has been a large amount of systematic development work carried on at many localities throughout the State on properties that have not been producers for many years, and a number of these are now in a condition so that they will be producers of these metals in 1904. Many of the properties that were producers in 1902 largely increased their production in 1903, and have enlarged their mills and reduction plants so as to be able to treat a greater output of ore during the next year. Experimental work has been carried on to some extent to determine the feasibility of treating many of the sulphide ores in the State by the cyanide process, and at the Colossus mine (formerly the Howie mine) in Union County, such ores are being successfully treated.

MINES PRODUCING GOLD AND SILVER IN 1903.

In 1903 there were 37 properties that could be designated as working mines that made a production of gold and silver. These were

located in 17 different counties. In the table below there is given a list of these mines and the counties in which they are located:

MINES IN NORTH CAROLINA PRODUCING GOLD IN 1903.

NAME OF MINE.	COUNTY.	NAME OF MINE.	COUNTY.
Boger	Cabarrus.	Alden & Merrill.....	Moore.
Miami (formerly Phoenix)	Cabarrus.	Mann-Arrington	Nash.
Shuford	Catawba.	Holloway*.....	Person.
M. Ramsay	Cherokee.	Tingen*.....	Person.
Norlina	Davidson.	Yancey*.....	Person.
Blue Wing*.....	Granville.	Lilian	Polk.
Portis	Franklin.	Cid	Randolph.
Deep River	Guilford.	Sawyer or Stillwater..	Randolph.
Fentress	Guilford.	Gold Hill*.....	Rowan.
Gardner	Guilford.	Whitney (formerly	
Lindsay	Guilford.	McMakin)	Rowan.
McCullough	Guilford.	Union*.....	Rowan.
Capps Hill	Mecklenburg.	Barringer	Stanly.
Surface Hill	Mecklenburg.	Ingram or Crawford..	Stanly.
Summerville or		Parker	Stanly.
Wilhelmina	Mecklenburg.	Colossus (formerly	
Vein Mountain	Mecklenburg.	Howie)	Union.
Iola	Montgomery.	Indian Trail (formerly	
Montgomery	Montgomery.	Black)	Union.
Russell	Montgomery.	Moore	Union.

Of the above mines, those marked with an asterisk are copper mines, from the ores of which, however, there is obtained more or less silver and gold as by-products. It might be stated here that nearly all of the silver obtained in North Carolina is as a by-product from the copper mines. The gold is very free from silver, as is indicated by the table on page 17, which gives the production of gold and silver by counties for the year 1903.

In Cabarrus County the Miami Mining Company have been carrying on extensive development work at the Phoenix mine up to January, 1904, this property having been opened up by means of five shafts, six drifts and cross-cuts amounting to 3,932 feet. The deepest shaft is the Old Phoenix, which has been sunk to a depth of 604 feet with 547 feet of drifts on the 150-ft. level; 404 feet of drifts on the 250-ft. level; 594 feet of drifts on the 350-ft. level, and 489 feet of drifts on the lowest or 420-ft. level. From the 420-ft. level a winze 15 feet deep has been sunk and on the 350-ft. level there are a few short cross-cuts. The next deepest

shaft on the property is the Furniss, which is 170 feet deep with 140 feet of drifts on the 100-ft. level and 204 feet of drifts on the 170-ft. level, which also has 84 feet of cross-cuts. The total underground workings of the Phoenix mine are as follows:

UNDER-GROUND WORKINGS OF PHOENIX MINE.

NAME OF SHAFT.	NUMBER OF FEET.			TOTAL.
	SHAFTS.	DRIFTS.	CROSS-CUTS.	
Phoenix	101	45	6	152
Junction	70		63	133
Copper	150	234		384
Old Phoenix	604	2,034	27*	2,665
Furniss	170	344	84	598
Total	1,095	2,657	180	3,932

*Includes a 15' winze on 420' level.

The working shafts are double compartments, each measuring 4x4 feet. It is estimated that there are about 35,000 tons of ore blocked out in this mine, the vein averaging 16 inches in width. The mine is equipped with a 10-stamp mill, each stamp weighing 1,050 pounds, and Bartlett concentrating tables. The tailings are cyanided.

While this property produced but little gold in 1903, it is expected that during 1904 it will add considerably to North Carolina's production of this metal.

The North Carolina Mining and Milling Company have been developing a property in Cabarrus County about 4 miles southeast of Concord and 2½ miles north of the Phoenix mine. There has been about 130 feet of shafting sunk on the vein during the development work, but not sufficient work has as yet been done to determine the actual value of the property or to warrant the erection of a mill.

In the Lytton Mining District, near Lytton, Tabernacle Township, Randolph County, North Carolina, there are a number of properties that have been opened up during the past year. Some of these are new ones that have never before been developed, while others are old mines that have been re-opened. The Southern Homestake Gold Mining Company is operating a free milling ore that occurs as parallel bands in a schistose rock, and one of these veins has been opened by a

series of open cuts across the vein for a distance of 12,000 feet along the strike. This is a low-grade ore, averaging from \$3 to \$5 per ton, and this company expect to erect a cyanide plant to recover the values. A few prospect shafts or pits have been sunk on the vein for a depth of 25 to 50 feet. On the Senter gold mining property there are two similar veins or bands of gold-bearing schistose rock that have been opened for a distance of about 4,000 feet along the strike by means of open cuts, pits and short drifts. The width of this gold-bearing strata varies from 100 to 300 feet. The deepest work that has been done is the sinking of one shaft to 70 feet. This property would be another of those that could be worked by open cuts for some years. The Empire gold mining property has the same character of ore and has been developed by means of open cuts and pits. Other properties, in this same district, that contain deposits of a similar character and that have been opened up during the past year are those of the Pierce Mountain Gold Mining Company; the Miller Gold Mining Company; the Jones Gold Mining Company, and the Cameron Mountain Gold Mining Company, the latter adjoining the Southern Homestake Mining Company's property. The Cameron Mountain property has been opened to a depth of 125 feet. All these properties contain low-grade ores and, as sampled by various engineers, have given values ranging something as follows: \$2.50, \$3.90, \$4.80 and \$5.10 per ton. In former years these ores have been worked to some extent by means of Chilian mills; but it is the intention of those now owning these properties to treat them by cyaniding.

Another mine in Randolph County that has been re-opened during the past year is the Parrish mine, and the result of the development work carried on has been the opening up of a vein $3\frac{1}{2}$ feet wide, which is composed almost entirely of actinolite. As far as opened, the ore is free milling and gave on assaying values ranging from \$20 to \$30 per ton. The vein has been opened to a depth of about 30 feet.

The Whitney Company of Salisbury, North Carolina, is actively developing the Barringer mine in Stanly County and the McMakin mine in Rowan County. During the year 1903 there was 450 feet of new drifts made at the McMakin mine, Gold Hill, Rowan County, making, up to January, 1904, a total of 7,712 feet of development work that has been done at this mine, divided as follows: Shafts,

1,621 feet; drifts, 3,635 feet; cross-cuts, 2,456 feet. The deepest shaft on this property is now nearly 700 feet. The property is equipped with a 10-stamp mill that operated during 1903 on ore from this mine averaging from \$10 to \$30 per ton.

The Barringer mine, which is 1 mile southwest of Gladstone, Stanly County, was developed in 1903 to the extent of 150 feet of shafts, 395 feet of drifts and 92 feet of cross-cuts. This makes the total amount of under-ground work to January, 1904, 1,060 feet, of which 204 feet were shafts, 681 feet drifts, and 175 feet of cross-cuts. The ore mined was treated at the mill of the McMakin mine. The deepest shaft on this property is now 175 feet. Both of these mines were producers of gold in 1903.

Besides these properties, the Whitney Company own the Yadkin and Virgilina Copper and Land Company, which is an organization resulting from the merger of a number of mineral properties located in the neighborhood of Virgilina, Virginia. The Yadkin Mines Consolidated Company was formed by the merger of the Old Russell mine and a number of adjoining properties located in Montgomery County. No work of any particular importance was done upon these properties during 1903, and it is the intention of the Whitney Company to postpone any active developments on these properties until the large operations that are being undertaken by this company at the Narrows of the Yadkin river are fully completed. As soon as the installation of the electric power plant is finished at the Narrows of the Yadkin, extensive development work and mining operations will be carried on by this company at their numerous properties in the surrounding districts of North Carolina.

The mine producing the most gold during 1903 was the Iola in Montgomery County. This mine is owned by the Iola Mining Company, who own a tract of land containing some 52 acres, which is located 2 miles northwest of Candor, a station on the railroad running from Ashboro to Aberdeen. The property has been opened by means of two shafts, one at an inclination of 45 degrees following the dip of the vein whose strike is N. E.-S. W. This shaft has been sunk 173 feet and from it five levels have been started. The second shaft is a vertical one and was started 225 feet from shaft number one. It has been sunk to a depth of 200 feet. At the 150-ft. level a cross-

cut has been made to the vein connecting with the drifts from shaft number one. The length of this cross-cut is 110 feet. This shaft will encounter the vein, if it holds its present dip, at a depth of 275 feet. The mine is equipped with a 20-stamp mill and amalgamating tables. A cyanide plant has been installed to treat the tailings and works satisfactorily. It has been estimated that there has been about \$165,000 in gold taken from this mine.

The Oak Hill Mine, near High Point, Guilford County, was developed during 1903 by the Oak Hill Mining Company with satisfactory results. While there has been thus far no shipment of ore or concentrates, it is expected that this mine will be one of the producers of gold in 1904.

The Enterprise Gold Mining, Milling and Investment Company is developing a property within a few miles of Burlington, Alamance County.

The Nibelong mine in Caldwell County, 11 miles north of Morganton, Burke County, and owned by the Blue Ridge Mining and Milling Company, was developed during the latter part of 1903 to the extent of sinking one shaft 75 feet deep, at which level one drift was run 60 feet to the northeast and another 55 feet to the southwest. The vein averages about 2 feet in width. The property is equipped with a 5-stamp mill.

The Nor-Lin Mining Company, which is developing a property near Silver Hill, Davidson County, North Carolina, is erecting a small stamp mill and other necessary equipment for treating the ore.

At the Colossus mine, which was formerly the Howie mine in Union County, the ore is being successfully treated by cyaniding and is proving satisfactorily that North Carolina's low-grade ores are susceptible to cyanide treatment.

From the amount of development work that is being carried on in the State on gold properties, as is indicated from what has been said above, there is every reason for expecting a large increase in the production of gold in North Carolina during 1904 over that of the previous year.

PRODUCTION.

The total production of gold and silver in 1903 was valued at \$130,511 (coining value), which is an increase of \$6,649 over that

of 1902, which was valued at \$123,862. Of this product value of the gold was \$113,604, an increase of \$19,954 over 1902, which was valued at \$93,650. The value of the product of silver in 1903 of \$16,907 (coining value) was a decrease of 305 as compared with the value of the production of 1902 amounted to \$30,212. This large reduction in the value of the production is due to the large falling off in the production of ores, as nearly all the silver is obtained from these ores.

The 1903 production of gold and silver was divided among counties. The county producing the largest amount of gold was Montgomery with a production valued at \$48,635; while the second production was from Caldwell County, which is credited with a production valued at \$41,110. The county which was second in production of gold during 1903 was Stanly with a production valued at \$24,524; while Mecklenburg was third with a production valued at \$8,578. The production of silver was obtained principally from Person, Rowan and Granville Counties, from which was obtained nearly all of the copper produced in 1903. Person County produced the largest amount of copper, also produced the largest amount of silver, this being valued at \$8,632. Rowan County was second with a production valued at \$4,119 and Granville County was third with a production valued at \$2,259. The combined value of the production of silver in these three counties is \$15,010; while the total value of all the silver produced in 1903 was only \$16,907, indicating but a value of \$1,896 as having been obtained from gold. This indicates the fineness of the gold that is mined in North Carolina. In the tables below there is given the production of gold and silver in North Carolina during 1903 and 1902 by counties.

PRODUCTION OF GOLD AND SILVER IN 1903 BY COUNTIES.*

COUNTY.	GOLD.†	SILVER.†	TOTAL.
Burke	\$ 1,606.44	\$ 17.09	\$ 1,623.53
Cabarrus	3,237.23	85.93	3,323.16
Caldwell	41.10	.87	41.97
Catawba	1,181.07	19.09	1,200.16
Cherokee	1,144.52	5.91	1,150.43
Clay	46.51	.29	46.80
Cleveland	5,269.40	1.16	5,270.56
Davidson	230.12	161.52	391.64
Franklin	162.79	2.48	165.27
Gaston	196.84	2.85	199.69
Granville	562.68	2,258.97	2,821.65
Guilford	3,806.62	159.16	3,965.78
Halifax	423.81	2.63	426.44
Henderson	186.05	2.33	188.38
Iredell	133.84	1.60	135.44
Lincoln	522.42	9.90	532.32
Macon	93.02	.58	93.60
McDowell	2,260.15	30.60	2,290.75
Mecklenburg	8,578.72	102.89	8,681.61
Montgomery	48,634.83	878.27	49,513.10
Moore	388.87	8.04	396.91
Nash	139.54	2.15	141.69
Orange	351.46	5.11	356.57
Person	1,096.15	8,632.24	9,728.39
Polk	602.21	4.22	606.43
Randolph	396.30	6.96	403.26
Rowan	1,852.39	4,119.21	5,971.60
Rutherford	1,322.20	16.91	1,339.01
Stanly	24,524.30	116.05	24,640.35
Union	3,101.84	95.68	3,197.52
Warren	139.54	1.75	141.29
Unknown	1,370.59	154.22	1,524.81
Total	\$113,603.55	\$ 16,906.66	\$ 130,510.11

*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

PRODUCTION OF GOLD AND SILVER IN 1902 BY COUNTIES

COUNTY.	GOLD.†	SILVER.†	TOTAL
Burke	\$ 3,536.19	\$ 42.07	\$ 3,578.26
Cabarrus	1,049.30	87.20	1,136.50
Caldwell	18.60	.11	18.71
Catawba	1,544.93	15.97	1,560.90
Chatham	127.76	2.55	130.31
Cherokee	1,221.86	5.67	1,227.53
Clay	198.14	1.41	200.55
Cumberland	18.60	.11	18.71
Davidson	603.24	367.77	971.01
Franklin	625.77	6.24	632.01
Gaston	205.30	3.19	208.49
Granville	253.23	937.75	1,190.98
Guilford	929.45	36.57	966.02
Halifax	1,350.56	5.14	1,355.70
Henderson	490.19	10.63	500.82
Iredell	231.61	2.89	234.50
Lincoln	144.74	.54	145.28
Macon	93.02	.58	93.60
McDowell	2,048.85	36.63	2,085.48
Mecklenburg	20,439.58	860.41	21,300.99
Montgomery	38,498.15	675.00	39,173.15
Moore	542.75	19.55	562.30
Nash	292.24	6.79	299.03
Orange	504.70	18.71	523.41
Person	1,241.47	10,520.50	11,761.97
Polk	1,325.70	12.98	1,338.68
Randolph	1,064.48	11.30	1,075.78
Rowan	10,131.17	16,401.86	26,533.03
Rutherford	2,241.15	27.96	2,269.11
Stanly	862.03	5.00	867.03
Union	719.90	34.45	754.35
Warren	118.86	1.73	120.59
Unknown	976.78	53.21	1,030.99
Total	\$ 93,650.30	\$ 30,212.47	\$ 123,862.77

*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

As is seen from the above tables, Chatham and Cumberland counties, which made a small production of gold and silver in 1902, were not producers in 1903. Cleveland County was added to the list of producers in 1903, and is fourth in the value of its production of gold and fifth in the value of its combined production of gold and silver.

The production of gold in North Carolina since 1882 is given in the table below:

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA
FROM 1882 TO 1903.*

YEAR.	GOLD.	SILVER.	TOTAL.
1882	\$ 190,000	\$ 25,000	\$ 215,000
1883	167,000	3,000	170,000
1884	157,000	3,500	160,500
1885	152,000	3,000	155,000
1886	175,000	3,000	178,000
1887	225,000	5,000	230,000
1888	136,000	3,500	139,500
1889	145,000	3,878	148,878
1890	118,500	7,757	126,257
1891	95,000	6,465	101,465
1892	78,560	12,671	91,231
1893	53,600	17,325	70,925
1894	46,594	455	47,049
1895	54,200	520	54,720
1896	44,300	646	44,946
1897	34,600	388	34,988
1898	84,000	905	84,905
1899	34,500	388	34,888
1890	44,653	15,986	60,639
1901	60,410	34,023	94,433
1902	93,650	30,212	123,862
1903	113,604	16,907	130,511

*Coining value.

COPPER.

The production of copper ores in North Carolina in 1903 was considerably less than for the year previous, but there was, on the other hand, a considerable increase in the amount of development work that was carried on, which cannot but result favorably to the production of these ores during the next few years. The copper mine that has been worked the most extensively in the State was closed down during 1903 and the under-ground workings allowed to cave. This was the Holloway mine, which has been worked continuously from

1897 to 1904. During this period it has produced 16,695 tons of ore, from which there were obtained 1,613,550 pounds of copper, or 4.31 per cent. of copper to the ton of ore.

The Virgilina or Blue Wing District of Granville and Person counties was the scene of considerable mining and development work during 1903, and this district produced more copper than any other district in the State. The largest producer of copper in the district during 1903 was the old Yancey mine owned by the Person Consolidated Copper and Gold Mining Company, which is located about eight miles nearly south of Virgilina. This deposit is on a vein that is approximately parallel to the one on which is located the Holloway mine.

In this same district is the property of the Seaboard Copper Company, which is in Person County about 6 miles from Roxboro. This property has been developed by means of three shafts, 135, 200 and 105 feet deep respectively. From the 100-ft. level of the 200-ft. shaft, a drift 165 feet long has been driven, which connects with the 135-ft. shaft. On the 200-ft. level another drift is being driven to connect with the 135-ft. shaft, as this is sunk deeper. At the 100-ft. level of the 105-ft. shaft a drift has been started. It is estimated that there are on the surface about 1,200 tons of ore which will average approximately 6 per cent. copper.

The Salisbury Copper Company has re-opened what is known as the Holshouser mine, which is located near Crescent, Rowan County, about a mile from the Yadkin Railroad. A 5x10 vertical shaft is being sunk on the vein, and from it at a depth of 40 feet a cross-cut was driven across the vein which had a width of 15 feet. The vein is composed principally of quartz with auriferous copper and iron pyrites.

At the Gold Hill Copper mines, Rowan County, of which the Union Copper mine is the most extensively developed, there was but little work done during 1903, so that the production of copper and silver from this district was much less than during the previous year.

The Hercules Gold and Copper Company, whose property is at Cid, Davidson County, have been doing, during the past two years, as systematic development work as any other company in the State.

In this district the company own about 1,000 acres in fee-simple and have leased about 1,200 more. The copper deposit has been opened by means of 5 shafts which are approximately 40, 120, 180, 375 and 525 feet in depth respectively. Drifts have been driven at a number of levels from the shafts and a number of these are connected with each other. In carrying on this work as little ore as possible has been removed from the mine, and there has only been between 5,000 and 6,000 tons of ore raised to the surface. This is now on the dumps and will probably average 5 per cent. copper and about \$2 per ton in gold. The mine is equipped with a 50-ton water-jacket smelter and a concentrating mill. While this company made practically no production of copper in 1903, except what little was used for testing the value of the ore, they will, undoubtedly, during 1904, be added to the list of producers of both gold and copper in North Carolina.

The Twin-Edwards copper mine is in Guilford County, about one-half mile southwest of Greensboro and within one mile of the main line of the Southern Railway near Pomona. This property has not been worked since 1861, but during the past year it has been re-opened and some promising results as to the quantity of ore have been obtained. A sample of this ore, which was assayed at the laboratory of the Survey, gave the following results:

ASSAY OF ORE FROM TWIN-EDWARDS MINE.

	PER TON.	VALUE PER TON.
Gold	.343 oz.	\$ 6.86
Silver	Trace	
Copper	.8790	1.74

At the Everett mine, which is about $1\frac{1}{2}$ miles from Median P. O. and $1\frac{1}{2}$ miles from the junction of Sugar Fork creek and Hazel creek, no work was done during 1903 on account of litigation. This property has been systematically prospected and preparations were being made for the erection of reduction works for treating the ore, which will undoubtedly be completed as soon as the lawsuit is settled. In the upper workings of this mine some native copper and

considerable tenorite, the black oxide of copper, have been found. From one drift about 20 tons of this oxide of copper were taken out. It has been estimated that there are between 8,000 and 9,000 tons of ore on the dumps that were taken out during the development work. The property is equipped with four Rand drills, compressors, engines, boilers, etc., and all necessary tools for the employment of 125 men. Near the Everett mine on Hazel creek the Westfeldt Brothers of New Orleans are systematically developing a copper property to block out a certain tonnage of ore. The ore body carries from 4 to 5 per cent. copper, with some values in gold and silver.

There was a small amount of development work done in Jackson County on the properties of the Carolina Copper Company and the Cullowhee Copper Company in the central part of the county near Cullowhee, North Carolina. There was no production of copper, however, and the properties are still in the nature of prospects.

There was no work whatever done in the Ore Knob Copper District of Ashe County or the Peach Bottom Copper District of Alleghany. One of the main difficulties of operating these copper deposits in Alleghany and Ashe counties is their distance from railroad transportation as well as their distance from fuel.

PRODUCTION.

The total production of copper in 1903 was 438,133 pounds, valued at \$67,037. This is less than one-third the production of 1902, which amounted to 1,417,020 pounds, valued at \$212,553. This is also a decrease of 54,533 pounds in quantity and of \$9,863 in value as compared with the production of 512,666 pounds, valued at \$76,900, in 1901. The total tonnage of crude ore mined in 1903, from which the 438,133 pounds of metallic copper were obtained, was 4,106 tons. This ore contained from 3 to 27 per cent. of copper and a large part of it was concentrated before shipment.

Considering the amount of development work that was done in 1903, there should be a considerable increase in the production of copper in 1904 over that of 1903. In the following table there is given the production of copper for the years 1901, 1902 and 1903:

PRODUCTION OF COPPER IN NORTH CAROLINA IN 1901, 1902 AND 1903.

YEAR.	CRUDE ORE MINED.	COPPER PRODUCED.	VALUE.
	TONS.	POUNDS.	
1901 -----	10,398	512,666	\$ 76,900
1902 -----	16,741	1,417,020	212,553
1903 -----	4,106	458,133	67,037

IRON.

The iron deposits of North Carolina were worked more extensively during 1903 than for many previous years. The Cranberry mine, at Cranberry, Mitchell County, owned by the Cranberry Furnace Company, continues to be the largest producer of iron ore. This mine, which furnishes magnetic iron ore, is the most famous mine in the State and has been the only constant producer of iron ore. It furnishes a pig iron of superior quality.

The Wilson mine, at Wilson's Mills, Johnston County, was worked almost continuously for the first six months of 1903; but then, owing to the shutting down of the Greensboro furnaces, the mine also was obliged to close down. The ore obtained from this mine is a limonite containing, according to the analyses of the average run of ore, as follows:

COMMERCIAL ANALYSES OF LIMONITE ORE FROM WILSON MINE.

Metallic iron -----	49 to 51 per cent.
Phosphorus -----	.3 to .55 per cent.
Sulphur -----	None.
Manganese -----	Trace to .3 per cent.
Silica -----	4 to 18 per cent.

The body of ore is apparently large, and if the smelter at Greensboro should again start up this mine would undoubtedly once more become a producer of iron ore.

There was no production of iron ore from the Madison County deposits during 1903.

The litigation over the Ballou iron mine, which has been going on for a number of years, has finally been settled, and it is now very probable that this property will again be opened up, as it contains a large quantity of ore of good quality. It is but about 60 miles from

this property to the West Virginia coal fields, and if the projected railroad from these coal fields to the coast is built it will bring these iron mines in easy communication with the coal fields, which would be the means of their being developed on a large scale and the erection of furnaces for the reduction of the ore.

The deposits of limonite iron ore at Ore Hill, Chatham County, were worked to some extent during 1903, the ore being shipped to the furnace at Greensboro.

PRODUCTION.

The blast furnace at Greensboro, Guilford County, North Carolina, operated by the Empire Steel and Iron Company, was put in operation in January, 1903, and was run less than half the time until October 19, when it was blown out indefinitely. During this period there was used 17,984 tons of ore. The shutting down of this furnace means the closing down of the mines in Johnston and Chatham counties, as these ores cannot be shipped at a profit to other furnaces.

The total production of iron ore in 1902 was 82,881 tons, valued at \$78,540. This is an increase of 48,545 tons in quantity and of \$25,769 in value as compared with the production of 34,336 tons, valued at \$52,771, in 1902.

PYRITE.

Until 2 years ago pyrite was mined to a considerable extent in North Carolina, the principal deposit being the Oliver mine, 4 miles from Crouse, Gaston County. Since, however, this mine passed into the possession of the Virginia-Carolina Chemical Company, it has been shut down. In 1903 there was no production whatever of pyrite for use in the manufacture of sulphuric acid.

TIN.

The mineral cassiterite, tin oxide (SnO_2) containing 78.6 per cent. of metallic tin, is the only commercial source of the metal tin. This mineral is found in North Carolina in what is known as the Kings Mountain district, which extends across the southeastern corner of Cleveland County and across Gaston and Lincoln counties. From Grover, South Carolina, a station on the Southern Railway, to within a few miles of Lincolnton, Lincoln County, North Carolina, a distance of over 14 miles, tin ore has been found almost continuously,

and it is reported to have been found a few miles northeast of Lincoln; but no authentic record of this discovery can be obtained. The principal deposits that have thus far been located are in the vicinity of the town of Kings Mountain; on the southern end of Chestnut Ridge, about $2\frac{1}{2}$ miles northeast of Kings Mountain; and on the John E. Jones plantation, 7 miles northeast of Kings Mountain.

The Southern Railroad passes over a considerable portion of the tin belt, following almost the general direction of the formation from Kings Mountain to Gaffney, South Carolina. At the former place the railroad turns sharply to the east, crossing the tin belt, which continues toward the northeast. Thus, any commercial deposits that may be developed will have good railroad facilities, not being more than a few miles from the railroad. Those on Chestnut Ridge are not over 2 miles from the railroad, and the ore mined could easily be hauled to the railroad at small expense. If the Jones deposit proves to contain tin in any large quantity it would still be profitable to haul the ore to the railroad at Bessemer City, a distance of about 4 miles, if it did not prove feasible to build the railroad to the deposits.

In order to obtain some idea of the percentage of cassiterite that the veins contain, a sample was taken across a $2\frac{1}{2}$ -foot vein at the Jones mine which gave, on crushing and panning, a concentrate of practically pure cassiterite representing from 5 to 6 per cent. of the vein. This would represent about $3\frac{1}{2}$ per cent. of metallic tin. An ore carrying such a percentage of tin would, if in quantity, make a profitable proposition. Favorably located deposits have been worked that did not carry over $1\frac{1}{2}$ per cent. of metal.

There was considerable prospecting done during 1903 on the North Carolina tin deposits and a ton or more of tin concentrates obtained. A full description of the Carolina tin deposits is given in the recent report published by the North Carolina Geological Survey on the Carolina Tin Deposits, which is published as Bulletin No. 19.

ABRASIVES.

The abrasive materials are among the most important of the minerals mined, and their production depends largely upon our manu-

facturing industries. Any decided increase in manufacturing will cause an increase in the amount of abrasive materials used, and although there may be a decrease in some particular abrasive, there will be a corresponding increase in some other. The abrasive materials are readily divided into three groups, as follows:

1. Those which occur as a rock formation and are cut and manufactured directly into the form desired while retaining their original rock structure and appearance, as grindstones, scythestones, etc.
2. Those which occur as a constituent of either a rock or a vein and have to be mechanically separated from the associated gangue and cleaned, as corundum, garnet, etc.
3. Artificial abrasives, as carborundum, crushed steel, etc.

The abrasive materials constituting these three groups are oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, pumice, infusorial earth and tripoli, crystalline quartz, garnet, corundum and emery, feldspar, carborundum, crushed steel, artificial corundum and adamite. Of the above those that are found in North Carolina are materials for making buhrstones and millstones; suitable material for grindstones and whetstones, quartz, garnet, corundum and emery. Of these, however, the only ones that have been mined for abrasive purposes during recent years are garnet, corundum and millstones.

CORUNDUM.

The corundum deposits of North Carolina were the first to be worked for this mineral in the United States, and for a number of years this State produced all of the corundum (except emery) used in the United States. Until within the last three years North Carolina had been the largest producer of corundum of any State in the country.

For the past few years, however, there has been but very little corundum mined, and during 1903 the only production of corundum was by the North Carolina Corundum Company, whose property is located at Buck Creek, Clay County. They have erected a large and complete mill for cleaning and sizing their corundum ore, which will make a very pure and efficient corundum. As this company was the only producer of corundum, their statistics are included in the total production of abrasives and are not given separately.

GARNET.

A new locality for garnet for abrasive purposes was partially developed in 1903 in Madison County by Mr. M. F. Drudy. The deposit is located on Little Pine creek, near Marshall, Madison County. The garnet crystals, which are of the almandine variety, occur in a band of chloritic schist about 20 feet wide, that can be traced across country for a distance of about 1 mile. The noticeable feature of this deposit is the remarkable size of the crystals, which average at least 2 inches in diameter, some having been found $7\frac{1}{2}$ inches in diameter. The crystals, though usually elongated, are well developed and dodecahedral in character. They are usually slightly altered on the exterior surfaces to chlorite, but on the interior they are sound and break with a clean, sharp, cutting edge. They are readily separated from the enclosing rock, and a pure garnet product is easily obtained. None of this garnet was mined in 1903; but mining operations were begun early in 1904, and the product already shipped has been received very favorably. On account both of the ease with which this garnet can be mined and separated and of its quality, it should readily be able to compete with any other garnet. The property is well located for railroad transportation facilities, being on the main western line of the Southern Railway, running from Salisbury, N. C., to Chattanooga, Tenn. While there was no production of garnet from this locality, sufficient work has been done to demonstrate the existence of a large quantity of the garnet and that it can be mined and cleaned and prepared for market in competition with garnet from other localities. Its abrasive efficiency is equal to the New York or Connecticut garnet.

The production of garnet in 1903 was from the Sugar Loaf mine near the summit of Sugar Loaf Mountain, Jackson County, about $1\frac{1}{2}$ miles from Hall, a station on the Murphy branch of the Southern Railway. The production is not given separately, but is included under the total production of abrasives.

MILLSTONES.

For a great many years, millstones or buhrstones have been manufactured in the mountain sections of the State for local purposes. It is, however, only within the past three years that any attempt has

been made to produce a millstone for commercial purposes. These stones are now being made out of the granitic rock which occurs at Faith, Rowan County, and these are manufactured by Mr. J. T. Wyatt and Mr. F. J. D. Fisher, both of Faith. The production of these stones for 1903 was 63 pairs, valued at \$902, which were sold principally in North Carolina and Georgia. The demand for millstones or buhrstones has been increasing during the past few years for use in grinding the coarser cereals, mineral paint ores, fertilizers, cement rock, barytes and other minerals; and for which purposes the Rowan stone should give good satisfaction. Formerly millstones were used in very great number, principally for grinding wheat, but with the introduction of the roller-mill process there was a large falling off in the demand for the natural stone.

PRODUCTION OF ABRASIVES.

The combined production of garnet and corundum in 1903 amounted to 403 tons, valued at \$12,250, as compared with 260 short tons, valued at \$10,040, in 1902. This is an increase of 143 tons in quantity and of \$2,210 in value. The production of 63 pairs of millstones, valued at \$902, makes the total value of the production of abrasive materials in 1903 \$13,152, as compared with a total value of \$11,465 in 1902, an increase of \$1,687. The production of these abrasive materials for 1901, 1902 and 1903 are given in the following table:

PRODUCTION OF ABRASIVE MATERIALS IN 1901, 1902, 1903.

KIND.	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
	TONS.		TONS.		TONS.	
Corundum -----	325	\$ 48,840	260	\$ 10,040	403	\$ 12,250
Garnet -----	775	43,000	50	1,425		
Millstones -----	PAIRS.		PAIRS.		PAIRS.	
					63	902
Total -----		\$ 91,840		\$ 11,465		\$ 13,152

MICA.

The demand for North Carolina mica is still in excess of the supply that is produced each year. On account of the comparatively low price at which mica is selling at the present time, which is especially true of the very large sheets which formerly brought very high prices, there is not the same interest in mica mining in the State as there was a decade ago. The new uses of mica for insulating purposes in electrical apparatus, which has created this large demand for mica, does not require the finest quality of mica like that obtained from North Carolina, and as the phlogopite mica from Canada and that obtained from India give just as good satisfaction and can be imported at a very cheap rate, it cuts down the price of North Carolina mica for these purposes. For stoves, lamp chimneys and for every purpose where a perfectly clear, transparent mica is required, it is the North Carolina mica that is in demand. For these purposes alone, however, there is not a sufficient market at a high enough price to support the mica mines without the production of the small electrical sheets and scrap mica as by-products. For these reasons it is often a question with the small producer whether he can make his mine a financial success or not. Where, however, the production of mica is carried on on a large scale so that a quantity of it can be kept on hand, including the large sheets for stoves, lamp chimneys, etc., the small electrical insulator sheets, disks, etc., and ground scrap mica, to supply all exigencies of the market, the mining should make a profitable investment. It is necessary, however, to mine in a very conservative manner and to utilize every scrap of the mica. There is at times an opportunity of obtaining other minerals as by-products in connection with the mica, such as quartz and feldspar, to be used for pottery purposes; beryls for gems; and uraninite or pitch-blende for its radium contents.

Where formerly a large proportion of the scrap mica produced and put on the market was obtained from old dumps and piles of scrap mica, which were thrown away during mica mining of 20 or 30 years ago, when there was no demand at all for it, at the present time a considerable proportion of the scrap mica is that obtained as waste during the present mining, and also as scrap from the cutting of sheet mica. Thus, as would naturally be expected, there has

been a constant decrease in the production of scrap mica for the past few years, as many of the old dumps and piles of scrap mica have been thoroughly worked over and their scrap mica utilized. There has, however, been a constant increase in the production of sheet or plate mica during this same period.

PRODUCTION.

The total production of plate mica in North Carolina during 1903 has been estimated at 385,000 pounds, valued at \$86,300, this being an increase of 55,534 pounds in quantity and of \$4,647 in value as compared with the production of 1902 of 329,466 pounds, valued at \$81,653. The scrap mica produced in 1903 has been estimated at approximately 300 tons, valued at \$2,400, a decrease of 24 tons in quantity but an increase of \$181 in value as compared with the production of 324 tons, valued at \$2,219, in 1902. In the following table there is given the approximate value of the production of sheet mica by counties for the years 1900 to 1903, inclusive:

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900, 1901, 1902 AND 1903 BY COUNTIES.

COUNTY.	1900.	1901.	1902.	1903.
Ashe	\$	\$	\$	\$ 1,000
Buncombe			250	300
Haywood	11,000	11,500	20,000	18,000
Jackson	7,000	8,740	5,700	5,500
McDowell	1,000	500	600	1,000
Macon	5,200		4,000	3,500
Mitchell	26,722	33,506	28,203	29,000
Stokes	1,000		1,000	7,500
Transylvania	500	600	750	500
Yancey	12,788	25,003	21,150	20,000
Total value	\$ 65,200	\$ 79,849	\$ 81,653	\$ 86,300

QUARTZ.

PRODUCTION.

The mineral quartz is mined for a variety of purposes, such as the manufacture of glass and pottery; for abrasive purposes; as a flux and for gem purposes. In North Carolina the only direct mining for quartz is for use as a flux in copper smelting. Some quartz is found

which is used for cutting into gems and ornaments. The quartz in North Carolina that has been mined for flux in copper smelting has been obtained from near Ranger, Cherokee County, which is a station on the Atlanta, Knoxville and Northern Railroad; and from the Holloway mine, Person County. The quartz from Cherokee County has been used by the smelters of the Tennessee Copper Company at Ducktown, Tenn., and that in Person County by the Norfolk smelters. The total production of quartz during 1903 was 29,462 tons, valued at \$36,827, as compared with the production of 4,500 tons, valued at \$11,250, in 1902. This is an increase of 24,962 tons in quantity and of \$25,577 in value.

PRECIOUS STONES.

There is a great variety of gem minerals found in North Carolina at many different localities, principally in Mitchell, Macon, Yancey, Iredell, Lincoln, Alexander, Burke and McDowell counties. In Mitchell County there are found many varieties of beryl, including the aquamarine, golden and yellow beryls, blue beryl, emerald beryl and emerald matrix. The blue beryl is a very handsome gem and its color and brilliancy make it a very attractive stone. This blue color in the gem beryl is not common, and adds considerable to the value of the stone. The deep golden beryl is another very attractive stone, for which there is a considerable demand, and it is also obtained in Mitchell County in some quantity. The yellowish beryls that are found here vary from light straw through pale yellow, golden, to a deep yellow color. The emerald matrix stones continue to attract a great deal of attention, and there is a considerable demand for the emerald beryl cut in this manner, which is cut similar to the turquoise matrix gems. Some of the emerald beryl, which is not perfectly transparent, but is still of a decided emerald color, is cut *en cabochon*, and it makes very handsome green gems. A few stones are obtained that are transparent and these are put on the market with the brilliant cutting. These gems are obtained for the most part in the vicinity of Spruce Pine, and the company producing the largest amount of them is the American Gem and Pearl Company of New York. The principal gems found in Yancey County are the aquamarine beryl, some of the largest having been obtained from the

Ray mine near Burnsville. In Macon County there is a greater variety of gem minerals found, including many of the corundum gems, principally the ruby and sapphire, rhodolite, pyrope and almandine garnets; and aquamarines and golden beryls; and amethysts. The rhodolite, however, is the gem that is mined the most extensively in this county, and the American Gem Syndicate of St. Louis, Mo., is the largest producer. In Alexander County are found emerald beryls, hiddenite, quartz and rutile gems. In Iredell County the gem that is found in the largest quantity is the amethyst, and some of the finest found in the State are obtained from this county.

The demand for these semi-precious stones, as the rhodolite, beryl, etc., is constantly increasing and they are taking a place in the gem industry such as they have never done before, and the largest dealers in gem material are now putting on the market many of these semi-precious stones which formerly they would not handle at all. One reason, perhaps, for this is that these stones have a distinct color and character of their own and make up into the most attractive jewelry; and as they are brilliant and beautiful they are becoming to be appreciated for their real value, especially as the public is beginning to recognize them as distinct gems and not as imitations of others.

PRODUCTION.

There was but very little systematic mining for gems during 1903 and most of this work was confined to Mitchell County. The total value of the gems produced was \$1,525, which is a decrease of \$3,775 as compared with the value (\$5,300) of the production in 1902. There was but a very small production of the rhodolites, which is not due to the lack of demand for these stones, or, as far as can be learned, to the exhaustion of the deposits.

RARE MINERALS.

With the discovery of radium there has been considerable interest centered in the pegmatitic dikes of Mitchell County, which contain the uranium mineral, uraninite, or, as it is commonly known, pitchblende, the mineral from which all of the radium has been obtained. The mine that has produced the largest amount of this mineral is the Flat Rock mine near Spruce Pine, with smaller amounts from the

Buchanan, Wiseman and Deake mines. A small amount has also been found at the Ray mine, Yancey County. In comparing the pitch-blende found at Flat Rock mine with that from other localities, especially that from Bohemia, it was found that this Flat Rock pitch-blende showed a greater radio-activity than any of the others. This determination was made by Dr. B. B. Boltwood* of New Haven, Conn. At the Flat Rock mine there seem to be certain portions of the vein which contain the pitch-blende in some quantity, while in other portions a considerable distance may be traversed without encountering any of this mineral. As it is not evenly distributed in the pegmatitic dike, it is impossible to determine what percentage of this mineral could be obtained from systematic working of this mine. This mine has not been in operation for a number of years; but during the early working of the mine pitch-blende was thrown away. With the discovery of radium and the consequent demand for pitch-blende, the old dumps of this mine have been pretty thoroughly worked over by the people in the vicinity in search of this mineral, with the result that a good many pounds have been sold during the past year, the price rising from \$1 to \$9 per pound during the year. There are a number of other uranium minerals found in these pegmatitic dikes, some of which, such as the gummite, are surrounding the pitch-blende as an outer covering and have resulted from its direct alteration.

Samarskite, which is a mineral containing many of the rare earth metals, and also a small percentage of uranium, has been found in considerable quantity in Mitchell County, principally at the Wiseman mine. The demand for this mineral is not large, but during the past year the small amount that was obtained was sold readily at from 50 cents to \$1 per pound, according to the purity of the mineral.

PRODUCTION.

The total production of these rare minerals during 1903 was valued at \$270, the greater part of which was the value of the uraninite (pitch-blende).

*At the laboratory of Pratt & Boltwood, 139 Orange Street, New Haven, Conn.

MONAZITE AND ZIRCON.

INTRODUCTION.

On account of monazite and zircon being mined for similar purposes—*i. e.*, for the rare earth oxides that they contain—they are treated together in this report. The oxides obtained from these minerals are used in the manufacture of mantles for various incandescent lamps and for the glowers of electric lamps. The demand for monazite is increasing and considerable of that mined in the State is now being exported to Germany. All of the zircon mined, however, is consumed in the United States in the manufacture of the glowers for the Nernst electric lamp.

MONAZITE.*

Monazite, which is essentially an anhydrous phosphate of the rare earth metals, cerium, lanthanum and didymium, usually contains a varying but small percentage of thoria. It is the presence of this latter oxide that gives the monazite its commercial value. There is a very wide variation in the percentage of thoria that the monazite contains, but the commercial monazite that is put on the market contains from 3 to 9 per cent. of this oxide. The thoria, together with very small amounts of lanthanum and didymium oxides, are used in the manufacture of the cylindrical hood or mantle of the Welsbach and other incandescent gas lights. The cerium oxalate obtained in the separation of the other oxides, is used to a limited extent in pharmacy.

Monazite varies considerably in color, being light yellow to honey yellow, reddish, brownish and yellowish green, and has a resinous to vitreous luster. It is brittle, breaking with a conchoidal or uneven fracture, and is from 5 to 5.5 in hardness. The mineral is heavy, having a specific gravity of 4.64 to 5.3. By means of its color and specific gravity it can usually be readily identified.

Localities.†

Commercial deposits of monazite are not found in the original rocks, but in the gravel deposits of the present and former streams,

*United States Geological Survey : Mineral Resources of the United States, 1903.

†In the field work assistance has been rendered by Mr. Douglass B. Sterrett of Yale University.

which have resulted from the disintegration and erosion of the crystalline rocks which contain the monazite. These rocks have been altered and decomposed to a considerable depth, so that at the present time they are in a state of constant erosion; and their mineral constituents, monazite, zircon, magnetite, etc., are being deposited in the soils and gravels. This is going on to such an extent that even after the soils and gravels have been once worked for monazite, they may be re-washed at the end of the year and prove profitable sources of monazite.

The supply of monazite is obtained from Cherokee and Spartanburg counties, South Carolina, and from Rutherford, McDowell, Burke, Cleveland and Lincoln counties, North Carolina. There are large numbers of small miners in most of these counties who produce from a few pounds to a ton of monazite per year. Many of these do not concentrate their product beyond that effected by sluice-boxes, and they sell their material to some one of the four companies who are buying monazite, either for their own use or for exportation. These concentrates vary considerably in color, according to the locality from which they have been obtained, and there are consequently monazite concentrates of a red, red-brown, brown, yellowish brown, yellowish green and yellow color.

Rutherford County.—One of the main centers of the monazite mining industry in the State is Ellenboro, Rutherford County. Near this place is located the property of the German Monazite Company. This company is working 26 or more men, who wash out about $11\frac{1}{2}$ tons of cleaned sand each week. Their workable gravel is from 20 to 100 yards wide and extends for half a mile up and down the creek. The overburden, which has to be removed, is from 1 to 5 feet in depth, some of which carries a small amount of monazite.

Three miles from Ellenboro, at the Louisa Smart mine, three different colored monazite sands are found, which are not more than 100 yards apart, one being of a greenish color, another brownish red, and the third yellowish. The first is found along the small branch just above the drying plant, the second is found higher up on the hill-side, about 60 feet from the stream. These two gravels are being sluiced on but a small scale at the present time. These gravels pan well and were quite free from garnet, and contained but

a little of the black sand. The gravels are 3 feet thick, and are covered by 2 to 3 feet of an overburden of red clay. The third, or yellowish monazite sands, are now being washed; but they contain some garnet and heavy iron minerals. The brownish sand readily concentrates to a product containing 80 per cent. monazite. This property would be more extensively worked but for the lack of a sufficient water supply. Near these gravel deposits, a pegmatitic dike 4 feet in width was observed cutting the hornblende gneiss. This dike contained a great many garnets up to the size of a walnut and also monazite, which was proved by panning the crushed rock.

There are several places near Ellenboro where monazite is being mined. One is on the property of Mr. E. A. Martin, where a good percentage of monazite is obtained in panning the stream gravels and also the gravel for some distance under the banks; but the total area of the pay gravel is not large. Another is on the west fork of Sandy Run creek, on the land of Mr. J. C. Glover, where there is a considerable quantity of gravel, but it did not show a very large percentage of monazite on panning. The gravels are from 2 to 3 feet in thickness under an overburden of from 1 to 2 feet. There is, however, a good water supply which is favorable for working the gravels in quantity. Only two sluice-boxes were worked during the past year on this property. Again, on a small tributary of Sandy Run creek, on the land of Mr. J. D. Bridges, the stream-gravel and the gravel and soil on the banks are exceedingly rich in monazite, but the area of the gravels is not very extensive.

Three miles southeast of Ellenboro, on a small branch running through the plantation of Mr. D. B. Farrill, the gravels have been pretty well worked out once and are now being worked over the second time, yielding fairly good results. Only one sluice-box, however, was being worked during 1903, although there was a sufficient water supply for using several.

At Rutherfordton is another center of monazite mining and on the land of Mr. A. D. K. Wallace, 2 miles from Rutherfordton, considerable work has been carried on. The gravels in the bottom-land are often 100 feet across and from 1 to 3 feet thick. The overburden, which is not very heavy, contains some monazite and is washed similarly as the gravels. There are two branches on this

property containing workable gravel deposits, varying from 50 to 150 feet in width and about a quarter of a mile in extent. There is a good water supply on this property. About half a mile west of the Wallace deposits, on the land of Mr. H. Harris, the gravels that extend up and down the stream for a distance of nearly a mile have been washed. At Peppertown creek, where some mining has been done for monazite, the concentrates are low in monazite, being made up largely of black magnetic sand.

At Duncan, 17 miles from Ellenboro, on the land controlled by Mr. Henry Gettys, there are 30 acres of bottom-land, extending about a mile along the stream, which contain considerable monazite. The stream-gravels are to be washed first and then the bottom-land. Six or eight troughs will probably be used. In the same vicinity, on the land of Mr. S. A. Mode, the stream-gravels and bottom-gravels contain considerable monazite and there is a good supply of water.

Cleveland County.—On the land of Mr. A. M. Hunt, 6 miles from Casar, Cleveland County, there were two sluice-boxes operated in 1903, although the gravel deposits would warrant more, and there was an abundant water supply with which to develop them. The gravels panned very well, showing a good percentage of monazite. They varied in thickness from 2 to 3 feet, and there was good width of bottom-land that had only been partially worked out. Near the upper end of this land the stream-gravels are profitable to work over a number of times, as there has been no work done on the adjoining property and the rains are constantly bringing down new sources of supply of monazite.

In the vicinity of Carpenter's Knob, Cleveland County, there are some very promising gravel deposits containing monazite, a number of which are being worked by the Incandescent Light and Chemical Company of New York City. On the land of Mr. J. C. Crow, the bottom-land gravels are from 30 to 75 yards wide and will average about 2 feet in thickness. During 1903 there were 2 sluice-boxes at work on these gravels and 2 on the land of Mrs. Eliza Spakes further up the stream. These lands are on the head-waters of Little Knob creek. Further down on the creek, on the McSneed property, the monazite gravel was observed in one place to be 7 feet thick. Two sluice-boxes were in operation on this property, but there is a

sufficient supply of water to work more, which would be warranted by the quantity of gravel. Little Knob creek has been worked more or less from near its source to its mouth, but in many places the gravels have received new supplies of monazite, so that it will pay to wash them again. On the property owned by the Incandescent Light and Chemical Company, five sluice-boxes were operated in 1903 and the stream-gravel will be worked for about a mile. In a number of instances, bottom-gravels that had formerly been washed are now being washed again and at a profit. The gravel in some places is 5 feet in thickness. This company also own and are working monazite gravels on Camp creek in Burke County, and the Lattimore mine near Shelby, Cleveland County. They expect to erect a concentrating or cleaning mill near Carpenter's Knob. Another good deposit of stream-gravel and bottom-land gravel is on the land of Mr. W. E. Ledford, near Carpenter's Knob. These gravels pan very well and there is a good water supply.

On Knob creek there are very extensive stream-gravels and considerable bottom-land gravels which, while they do not contain a very large percentage of monazite, are extensive in area, and as there is a good water supply they could be worked on a large scale and therefore could be mined profitably.

Near Mooresboro, Cleveland County, there are a number of small producers of monazite. The most work is done on the land of Mr. H. C. Burrus, who operated three sluice-boxes or troughs in 1903. There is a considerable area of bottom-lands, but only small portions of these are being washed for the monazite. The branch flowing through this property has been worked for a distance of about a mile and contains workable deposits of 100 yards in width. The concentrates, however, contain a rather large percentage of the black sand.

Burke County.—In Burke County, on Brindletown creek and its tributaries, are many properties containing good deposits of monazite gravels, such as those of Captain J. E. Mills, Mr. John Kirksey and Mr. Moore Epley.

McDowell County.—In McDowell County, there are numerous good deposits of monazite on the waters of Muddy creek, but an act of the Legislature prohibits the use of these streams for sluicing pur-

poses, and thus prevents the mining of monazite on the adjacent properties.

There is a tendency among a large number of the farmers who own lands containing monazite gravels to work only the stream-gravels, which they do two or three times a year, leaving the bottom-land untouched except for farming. The heavy rains wash the sands in from the hill-sides, from under the banks and from the streams above, thus renewing the monazite in the stream-gravel. These surface soils seem to contain a considerable per cent. of monazite for 6 or 8 inches of their depth, which has resulted from the decomposition and disintegration of the adjacent rocks. The sands that are obtained from the sluice-boxes are sometimes re-washed by the miners, but usually it is sold directly to some one of the companies owning the concentrating plants.

Methods of Drying Monazite Concentrates.

The weighed concentrates are dried in two different ways. One way consists of spreading the sand over an oiled or rubber cloth in the sun, where it dries very quickly, due partly to the heat absorbed by the dark iron sand. The other method of drying is by heating over a furnace. A small ditch from 4 to 8 feet long and 1 to 1½ feet wide and about 1 foot deep is dug, at one end of which there is built a rock or brick chimney. Over the ditch there is a sheet-iron cover. The monazite is spread out on this sheet-iron drying-plate, under which there is a hot fire.

Concentrating Mills.

The concentrating mills that are now being operated in the monazite district are those of the Carolinas Monazite Company, located at Shelby, Cleveland County, North Carolina, and Gaffney, Cherokee County, South Carolina; that of the German Monazite Company at Oak Springs, Rutherford County; and that of the Incandescent Light and Chemical Company near Carpenter's Knob, Cleveland County.

Further cleaning of the concentrates that are obtained from the sluice-boxes by the miners has been perfected to such an extent that now a cleaned monazite sand can be obtained that is from 95 to 99 per

cent. monazite. This has been effected by means of the Wetherill Electro-magnetic Separator. The dried concentrates are placed in a hopper and from there fed to a classifier. The finer material, which contains the monazite, is allowed to pour over a revolving drum, and is thus scattered evenly over an 18-inch belt. This passes along under four powerful electro-magnets, which have small belts to carry the material attracted by the magnets out of the magnetic field. As soon as such a point is reached, the belt drops the sand, which passes through a chute to the proper receptacle, placed to receive it. The first magnet removes all the magnetic iron, the larger pieces of garnet and generally all of the titanitic iron or ilmenite. If any of the latter passes this belt it is removed with all of the finer garnet sand by the second magnet. The third magnet is so adjusted as to remove only the coarse monazite, and the fourth removes all of the finer pieces of monazite. The remaining sand, quartz, zircon, rutile, etc., is dropped off the end of the large belt and is run into the waste pile.

The garnet, which is of very good quality, having a hardness of 7.5, will, if it is obtained in some quantity, be of value for abrasive purposes. There is some gold contained in these tailings, but no attempt is made to save it.

In washing some of the monazite gravels, the gold which they contain is saved and in many instances has amounted to \$1 or more per sluice-box per day.

ZIRCON.

The mineral zircon is a silicate of zirconium (ZrSiO_4) and is commonly found in square tetragonal prisms terminated by the pyramid. It is usually of a grayish, light brown to a reddish brown color. Occasionally it is found colorless to red and perfectly transparent, when it becomes of value as gem material. In hardness it is 7.5 and has a specific gravity of 4.65. Besides the use that is made of the transparent varieties of this mineral for gems, there is a certain amount that is mined for its zirconia content. This oxide is used together with yttria in the manufacture of the glower for the Nernst electric lamp.

Occurrence and Localities.

Zircon is commonly found sparingly in the crystalline rocks, especially gneisses, syenites, granites, in granular limestones, and in chloritic and other schists. Occasionally it is found associated with some of the iron ores. Occurrences of this mineral in quantity are not common, and there is but one locality in the United States where it has thus far been found in commercial quantity and that is in the vicinity of Zirconia, Henderson County, North Carolina. The zircons occur in a pegmatitic dike which is about 100 feet wide and has a strike of N. 50° E. It cuts up through the old Archean gneisses, and can be traced for a distance of about 1½ miles. The upper portions of the pegmatitic dikes are badly decomposed and kaolinized to a depth of 40 feet or more. The zircons occurring in these dikes are of a grayish color and well crystallized, prismatic crystals terminated by the unit pyramid predominating. They occur for the most part in the feldspar, and where this is kaolinized it permits of an easy separation of the zircon crystals by hydraulic processes. As the feldspar becomes more solid and unaltered, the separation of the zircon is more difficult. In crushing the feldspar, however, the zircons readily free themselves from the gangue. There are two deposits of these zircon crystals that have been worked; one near the southwestern end of the pike, which is known as the Freeman mine, and the other near the northeast end, which is known as the Jones mine. Owing to the slight demand for this mineral, there is no systematic mining carried on. Men and children are paid a certain price per pound for the zircon crystals, some of which they wash out of the soil, others out of the kaolinized gangue, and still others they break out by hand from the harder feldspar. The resultant product contains practically 100 per cent. of zircon.

Near New Sterling, Iredell County, a great many brownish, pyramidal crystals of zircon have been found in the soil, some of which were 1 to 3 inches in diameter. One crystal weighed about 6 ounces. The exact occurrence of these crystals has not as yet been definitely determined, but thus far there has been observed no indication of a commercial quantity.

- There are small quantities of zircon found in all the monazite sands, which could probably be saved as a by-product. These crystals are very minute, and are transparent.

PRODUCTION.

The total production of monazite in North Carolina during 1903 was 773,000 pounds, valued at \$58,694, which is a decrease of 29,000 pounds in quantity and of \$5,466 in value as compared with the production of 802,000 pounds, valued at \$64,160, in 1902. The above amount represents the purified sand containing from 85 to 99 per cent. monazite. This was obtained from about 1,600,000 pounds of crude sand as taken from the sluice-boxes, which is the material that goes through the magnetic separators. The price received for this crude sand by the individual miner varied from 2½ to 6 cents per pound, according to the percentage of thorium that it contained. Cleveland County leads in the quantity and value of its production.

The quantity of zircon obtained in 1903 was 3,000 pounds, valued at \$570. This makes the total production of these minerals mined for use in the manufacture of various lamps amount to 865,000 pounds in quantity, valued at \$65,200. In the table below there is given the production and value of monazite mined in North Carolina from 1893 to 1903:

PRODUCTION OF MONAZITE IN NORTH CAROLINA FROM 1893 TO 1903.

YEAR.	POUNDS.	VALUE.
1893.....	130,000	\$ 7,600
1894.....	546,855	36,193
1895.....	1,573,000	137,150
1896.....	30,000	1,500
1897.....	44,000	1,980
1898.....	250,776	13,542
1899.....	350,000	20,000
1900.....	908,000	48,805
1901.....	748,736	59,262
1902.....	802,000	64,160
1903.....	773,000	58,694

BARYTES.

The principal use that is made of barytes is as a white pigment, and the first grade of this mineral, after being ground and made

ady for use, is known as "floated barytes." Whereas, formerly this mineral was considered as an adulterant, it is now recognized that barytes has excellent qualities of its own that make it of value as a pigment. Hence, at the present time, barytes is put on the market as a pigment and in competition with white lead and other white pigments. It has a pure white color, which is permanent, and it is unaffected by the weather or by gases that in some cases blacken white lead. It can also be used to advantage in combination with other white pigments, as white lead or zinc white. Of the total production of barytes, about four-fifths is used in the manufacture of white pigments. Other uses are in the manufacture of paper and rubber and also in the preparation of material that is used to coat canvas sacks in which hams are wrapped and made ready for market. Another use for this mineral that is increasing is in the manufacture of other barium compounds, principally the hydroxide.

Barium hydroxide was formerly prepared almost exclusively from the mineral witherite, barium carbonate; but on account of its rare occurrence in commercial quantity manufacturing chemists have been obliged to take up barytes as the raw material for manufacturing the hydroxide and other salts of barium. The principal use of barium hydroxide is in the beet sugar industry for the separation of the sugar left in the molasses. It is applicable in the same manner in the cane sugar industry. Another application that can probably be made of barium hydroxide which would cause it to be used in considerable quantity, is as a purifier of water used in some boilers. This would be especially applicable to acid waters. Still another use that has been considered is in the preparation of hides for tanning. As a pigment there are many ways in which barium white can be used, either as a preparation of the sulphate or as double salts.

PRODUCTION.

The production of crude barytes in North Carolina during 1903 was obtained principally from Madison County, with a small quantity from Gaston County, and amounted to 6,835 tons, valued at \$21,347. This is a decrease of 7,844 tons in quantity and of \$22,783 in value, as compared with the production of 1902, which was 14,679 tons, valued at \$44,130. The average value per ton of the 1903 produc-

tion was \$3.12½. In the following table there is given the production of barytes in North Carolina for the years 1901, 1902 and 1903:

**PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA DURING
1901, 1902 AND 1903.**

YEAR.	QUANTITY, SHORT TON.	VALUE.
1901.....	6, 890	\$ 20, 865
1902.....	14, 679	44, 130
1903.....	6, 835	21, 347

The quality of the North Carolina barytes is of the best, and as the demand for barytes is constantly increasing it was expected that the production of 1903 would have been at least equal to that of 1902. One thing that is against these deposits is their distance from the market, the crude barytes being shipped either to Lynchburg, Va., or Bristol, Tenn., or St. Louis, Mo. Thus the Virginia, Tennessee and Missouri deposits have an advantage in freight over those of North Carolina.

TALC AND PYROPHYLLITE.

PRODUCTION.

The demand for North Carolina talc, such as is found at the Hewitt mine in Swain County, is at the present time considerably greater than the supply. This particular deposit is unique in its occurrence and furnishes a talc which is much sought after for the manufacture of tailors' pencils, etc. The counties producing talc in 1903 were Swain, Cherokee, Madison and Jackson, given in the order of the importance of their production, while the pyrophyllite was obtained from Moore County. There is a small amount of the soapstone variety of talc quarried each year in the mountain counties, Alleghany, Yancey and Mitchell, which is used for fire-places, etc. The total production of these minerals in 1903 amounted to 5,331 tons, valued at \$76,984, which shows an increase of 92 tons in quantity, but a decrease of \$11,978 in value as compared with the production for 1902 of 5,239 tons, valued at \$88,962. The decrease in the value, with a slight increase in quantity, is due to the smaller

quantity of the higher-priced talc mined at the Hewitt mine. The largest amount of this production was obtained from Swain County, with smaller productions from Cherokee and Moore counties. The condition in which this production was marketed is shown in the following table:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1901, 1902 AND 1903.

CONDITION IN WHICH MARKETED.	1901.		1902.		1903.	
	QUAN- TITY, SHORT TONS.	VALUE.	QUAN- TITY, SHORT TONS.	VALUE.	QUAN- TITY, SHORT TONS.	VALUE.
Round talc for powders, etc.	2,864	\$ 29,505	3,381	\$ 31,628	3,762	\$ 37,606
Talc cut into pencils, gas pips, etc.	375	26,000	371	42,017	265	27,615
Talc sold crude	2,580	22,319	1,487	15,317	1,304	11,763
Soapstone cut into slabs or chimneys, etc.	-----	150	-----	-----	-----	-----
Total	5,819	\$ 77,974	5,239	\$ 88,962	5,331	\$ 76,984

In the table below there is given the value and quantity of talc and soapstone produced in North Carolina from 1898 to 1903, inclusive:

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1903, INCLUSIVE.

YEAR.	QUANTITY.	VALUE.	YEAR.	QUANTITY.	VALUE.
	SHORT TONS.			SHORT TONS.	
1898	1,695	\$ 27,320	1901	5,819	\$ 77,974
1899	1,817	31,880	1902	5,239	88,962
1900	4,522	75,308	1903	5,331	76,984

GRAPHITE.

Although there is only a very small amount of graphite mined in North Carolina, yet on account of the numerous occurrences of this mineral throughout the State and of its high commercial value and demand, the subject is treated much more in detail than the actual

production of the mineral warrants. It is not improbable but that some of the localities where graphite is known to occur may develop into properties of commercial value, and this is especially true of some of those which at the present time are at some distance from railroad transportation, but which may, in the next few years, become available by reason of the railroads having penetrated into these districts.

Graphite is a mineral almost universally used, and there are but few households that are without it in one form or another. It is a mineral that was formerly but little understood, and even at the present time there is a vagueness regarding its value and uses and, in fact, regarding the character of the mineral itself. This is partially due to the different names that have been given to it in various localities in accordance with its uses, these names being graphite, black lead and plumbago. The mineral commonly occurs in embedded, foliated masses and also in granular, compact and micaceous masses, sometimes of a slaty structure and at other times earthy. Occasionally it is found in six-sided tabular crystals, but the faces of these are seldom distinct. In the foliated variety it has a perfect basal cleavage, the thin laminae when separated being flexible but not elastic. In color it varies from black to a dark steel-gray, and it has a metallic to sometimes dull and earthy luster and a greasy feel. In hardness it will vary from 1 to 2 and in specific gravity from 2.1 to 2.23, due to the amount of impurities. It closely resembles in physical properties the mineral molybdenite, a sulphide of molybdenum (MoS_2), which, however, gives a bluish-gray streak on paper, while the graphite gives gray-black. Chemically, however, the graphite is readily distinguished from the molybdenite, as its composition is carbon, although often impure from the presence of iron sesquioxide, clay, quartz, etc. The properties of graphite that make it especially valuable for the purposes for which it is used in the mechanic arts are softness, flexibility, low co-efficient of friction, conductivity, large adhesiveness, and exceedingly slow oxidation at high temperatures.

OCCURRENCES AND VARIETIES.

Graphite as a mineral is widely distributed in nature and occurs in gneisses, mica schists, crystalline limestones and pegmatitic dikes.

As an ore deposit, however, it is found in but few places, occurring in beds and embedded masses and laminæ or scales in the rocks just mentioned. Schists are often impregnated with graphite to such an extent that they become graphitic schists, and have been observed extending over a number of miles of territory. Occasionally it is found in meteoric irons from a fraction up to 3 per cent. The world's supply of graphite is obtained from the following countries: Austria-Hungary, Ceylon, Germany, United States, Canada, Italy, Japan and Mexico, with, however, the larger amounts obtained from Austria-Hungary and Ceylon, these two countries together producing nearly six times as much as all the other countries combined.

There are three distinct varieties of graphite on the market—crystalline, amorphous, and artificial. These are used to some extent for the same purpose, but there are some uses to which each is especially applied. Of the two natural forms of graphite the crystalline is the more valuable, and is usually a purer grade of graphite, being worth about \$70 per ton, while the amorphous is only worth about \$15 per ton. The artificial graphite averages still higher in value, about \$92 per ton, this being due to the particular form in which some of it is produced.

Crystalline Graphite.—This variety can be used for all purposes for which graphite is required, but its chief uses are in the manufacture of refractory products, lubricants, electrotypes, and pencils, for which it is especially adapted on account of its purity. It has been estimated that of all the crystalline graphite consumed in the country, 55 per cent. was for crucibles, 15 per cent. for stove polish, 10 per cent. for foundry facings, 5 per cent. for paint, and 15 per cent. for all other purposes, including pencils, powder glazing, electrotyping, steam packing, and various other minor uses.* The coarser and purer form of the crystalline graphite is used for the manufacture of crucibles, pencils, lubricants, and electrotypes, and is known on the market as lump graphite and chip graphite, the former being more valuable. For the other purposes, as in the manufacture of stove polish, foundry facings, paints, etc., those grades of crystalline graphite known as dust and sweepings are used, the dust having the higher price.

*Mineral Resources U. S. for 1902; U. S. Geol. Survey, 1904, p. 975.

The bulk of the world's supply of crystalline graphite is obtained from the island of Ceylon. The refining of crystalline graphite is accomplished with but little difficulty, and the resultant product is usually very pure and free from any injurious compound. In some instances masses of the crystalline graphite are obtained that need no refining, and are ready for the crusher after simply being hand-cobbed.

Amorphous Graphite.—The occurrences of amorphous graphite are very much more abundant than those of the crystalline variety, but on account of the difficulty experienced in refining the crude ore, many of these deposits are not at the present time of commercial value. There are still others that are so isolated from railroad transportation facilities that it is impracticable to attempt to work them. Schists are often impregnated with graphite to such an extent that they become graphitic schists, and they have been observed extending over a number of miles of territory. Usually these schists contain also minute particles of quartz (silica), and although they may carry a very high percentage of graphite, it is impossible in many cases to obtain commercially pure and marketable graphite. This is due partly to the intricate manner in which the grains of quartz and graphite are intermingled, which makes it almost impossible to separate the quartz completely from the graphite, even by extremely fine crushing. Then again graphite and mica are found lying in parallel positions, so that it is almost impossible to separate the foliæ of one mineral from those of the other. In some instances the deposits of graphite are worked on a limited scale, and the production is shipped directly as mined for use for foundry facings and paints.

Such deposits of graphite occur very extensively in McDowell County, where there is a series of strata of graphitic schists in a country rock of mica schist and gneiss. These strata vary widely in percentage of graphite, some being quite lean and others richer. These graphitic schists can be traced for a distance of about 3 to 4 miles in a N. E.-S. W. direction from Brush Mountain on the west to Fork Mountain on the east. The deposit first becomes prominent near the Mill creek trestle of the Southern Railway. In width it is about 275 feet, with a very lean streak of the graphitic schist near the

center. The deposit occurs up and down five ridges, each of which rises to a height of 500 feet or more above the general level of this section of the country. Before attempting to work such deposits of graphite, they should be thoroughly tested as to whether or not they can be cleaned commercially. Deposits which may be very similar to each other, as far as one can judge from looking at them in the field or in the hand specimen, will differ very materially in respect to how they lend themselves to a cleaning process.

Another deposit similar to the above occurs three miles north of Raleigh, Wake County, and at these deposits graphite has been mined to some extent for the past four or five years.

The occurrence of graphite in pegmatitic dikes is well illustrated by the deposits in Alexander County about five miles from Taylorsville. The country rocks are schists and gneisses, and cutting through these are the pegmatitic dikes, varying from a few inches to 5 feet or more in thickness. The graphite, as it occurs in these pegmatitic dikes, is in the form of small particles and nodules from a fraction of an inch to 6 or more inches in diameter. As these pegmatitic dikes are more or less decomposed, the graphite in the upper portions of the dikes is more or less stained with iron oxide; but as the work on the deposit is continued deeper but little of the graphite was stained. The nodules of this mineral, when broken open, were found to be nearly pure, and on testing them no grit was observed. Nodules of the graphite occur quite abundantly on the eastern and northeastern slopes of Barrett's Mountain and for a distance of over 2 miles in a direction of a few degrees west of south. Only in a few places, however, in this belt has the graphite been located in place. What is apparently a similar occurrence of graphite has been found near Henrietta, Rutherford County, on the farm of Mr. Robert R. Simmons. The graphite has been found on the surface for over half a mile along the slopes of the ridge, and a number of pits have been sunk in an attempt to locate the graphite in place. The National Graphite Company continued the development of their graphite property in Yancey County about 7 miles east of Burnsville and will undoubtedly be shipping graphite late in the year of 1904.

There are large quantities of the amorphous graphite used in the manufacture of paints and for foundry facings. Some is also used in the manufacture of crucibles. The difficulty of purification of the amorphous graphite prevents its use for the manufacture of lubricants, the better quality of pencils, electrotypes, etc., except in a few instances, as in the case of some of that obtained from Bavaria and Mexico, and from one or two places in the United States.

Artificial Graphite.—Methods for the production of artificial graphite have been known for a great many years, but it is only within the last eight years that a method has been devised for manufacturing it commercially. The three principal methods by which artificial graphite has been made are: (1) By heating amorphous carbon to a very high temperature in the electric furnace. (2) By dissolving an excess of carbon in a molten metal at a high temperature; on allowing the metal to cool down the excess of carbon separates out as graphite. (3) By the dissociation of certain carbon compounds by means of metallic iron, or iron oxide, at high temperatures.

EXAMINATION OF GRAPHITE DEPOSITS.

On account of the constant increase in the demand for graphite, and of the fact that there is from six to ten times as much graphite imported into the United States as there is mined in this country, there is a great deal of interest aroused over the discovery of any large deposit of this mineral, especially of the crystalline variety. Any deposit of this mineral within reasonable distance of railroad transportation is worthy of investigation. There are, however, a number of points to be taken into consideration in estimating the value of a graphite deposit beside its location and cost of mining, which are: (1) Its variety, crystalline or amorphous. (2) The percentage of graphite in the ore. (3) The impurities that contaminate the ore, as mica, quartz, iron oxide, clay, etc. (4) Whether these impurities can be eliminated commercially. (5) The purpose for which the cleaned graphite can be used. Although it is important to know accurately the percentage of graphite that an ore carries, this is not of the first importance. It is very essential to determine whether or not the graphite ore can be so cleaned and refined as to produce a marketable product, and this should be deter-

mined before any large amount has been spent in the development of the deposit.

METHODS OF CLEANING.

The difficulties in purifying graphite have prevented the working of many deposits, even though they contain a considerable percentage of this mineral. The general methods employed for separating graphite from its impurities are based on the differences of specific gravity between it and its associated minerals. In these processes consideration is given to the difference in form between the particles of graphite and those of the gangue minerals. One of the minerals that is often difficult to separate from the graphite is mica, on account of its occurring in similar foliæ to that of the graphite, thus offering nearly the same surfaces to the solutions or blasts of air as the graphite. Briefly, the two principal methods used for purifying graphite have been described by Mr. W. F. Downs, E. M.,* as follows:

Treatment for purification by air.—This has long been a favorite field for experiment. The thin, flat scale of graphite offers more resistance to a current of air than an irregular fragment of gangue. The usual form of air jigs is further supplemented by settling chambers, dust-collectors, etc. These machines concentrate, but it is doubtful if they will make any pure graphite. Though frequently tried, they have never come into general use.

Treatment by water.—The amorphous grades are levigated on a large scale in Europe. This method frees the ore of coarse particles, but the earthy impurities carry over to the last settling vessel and much remains with the graphite. Even when the washing is carried to the extent that filter presses are used, clayey impurities still follow the graphite. The crystalline varieties occurring in the gneiss and schistose rocks are the most susceptible of treatment. These are crushed to a fineness sufficient to dissociate the graphite from the gangue, and first separated in buddles. This separation is of course incomplete, but when supplemented by sizing, regrinding, floating, etc., is carried to quite a high degree. These methods have attained great perfection in the United States.

For most of the purposes for which graphite is used it is not necessary to have it pure; but in the manufacture of electric goods, lubricants, and pencils, this is absolutely necessary. It is, however, the other uses that consume by far the most of the graphite that is mined.

*The Iron Age, May 3, 1900.

PRODUCTION.

The production of graphite during 1903 amounted to 50 tons, valued at \$245, as compared with a production of 830 tons, valued at \$4,300, in 1902. This is a decrease of 780 tons in quantity and of \$4,052 in value, and is due to the shutting down of the deposits at Graphiteville in McDowell County, which produced graphite in some quantity during 1902. The amount of graphite produced in the United States during 1903 was 18,860 tons, valued at \$225,554, of which only about 4,000 tons were used for the ordinary purposes of graphite. The balance of the production of 1903, which was sold at a price of about \$2 per ton, was used in the manufacture of fertilizers. Besides this natural production of graphite, there were 1,310 tons, valued at \$178,670, of artificial graphite produced. There was also imported into the United States 17,628 tons, valued at \$1,207,730. This makes a total of 22,758 tons, valued at \$1,568,559, after deducting the amount of graphite that was mined for fertilizer purposes. As is seen from the above, the amount of graphite imported for the manufacture of paints, lubricants, crucibles, slate pencils, etc., is about four times the amount produced in the United States, and thus emphasizes the benefit that would be derived by the United States if large deposits of commercial graphite could be found.

• COAL.

PRODUCTION.

There are no extensive coal fields in North Carolina, and the only deposits that have thus far been worked on a commercial scale are those in Chatham County known as the Cumnock mines. This coal contains more or less sulphur, and it is very probable that its value could be very materially increased by washing. At the present time this coal is valued at about \$1.46 per ton f. o. b. mines, the price per ton having increased from \$1.07 in 1901 and \$1.24 in 1902. Similar coal measures occur in Stokes County near Walnut Cove, but no development work was done on these deposits during 1903, although it is expected that during the coming year they will be thoroughly prospected. The production of coal during 1903 in North Carolina amounted to 17,309 tons, valued at \$25,300, as compared with the

production of 23,000 tons, valued at \$24,500, in 1902. This is a decrease of 5,691 tons in quantity but an increase of \$800 in value. The increase in value per ton of the 1903 production over that of 1902 was 22 cents.

STONE.

There is a great variety of stone suitable for building purposes occurring in North Carolina, but at the present time only a few of the deposits have been thoroughly developed. The stones that are being utilized are granite, sandstone, marble and limestone; while the deposits of slate and serpentine which occur in quantity and of good quality have not as yet been developed to any great extent. There was a consolidation of a number of quarries during 1903, which included the large granite quarries of Thomas L. Woodroffe & Sons at Mt. Airy, Surry County. The name of the new corporation is the North Carolina Granite Corporation, whose home office is at Philadelphia, Pa.

Although the condition of the stone industry in the State at the close of 1903 was much better than at the close of 1902, yet the actual value of the production during 1903 was somewhat smaller than that of the previous year. In 1903 the value of the total production of building stones was \$360,322, as compared with \$366,727, the value of the production in 1902, this being a decrease of \$6,405.

In the following table there is given the value of the productions of the different stones quarried in 1902 and 1903:

PRODUCTION OF BUILDING STONE DURING 1902 AND 1903.

STONE.	1902.	1903.
	VALUE.	VALUE.
Granite.....	\$ 338,749	\$ 334,357
Sandstone.....	4,825	600
Marble and Limestone.....	23,153	25,365
Total.....	\$ 366,727	\$ 360,322

During the year 1903 investigations were carried on in the field relating to the occurrences of building stones in North Carolina, and the results of this work will appear shortly as Volume 3 of the

North Carolina Geological Survey. This report takes up in detail a description of the occurrences of the various building stones, their economic value and chemical and mineralogical composition.

GRANITE.

Production.

The total value of all the granite produced in 1903 was \$334,357, which is a decrease of \$1,492, as compared with the value of the production for 1901 of \$335,749. This production does not begin to represent what the granite industry of the State should attain when the quality as well as the quantity of the various varieties of granite are considered. Many of the quarries are very well located for railroad transportation and the occurrences of the stone are such that they can be quarried the most economically. The number of operators engaged in quarrying granite during 1903 was 24, who worked at 26 different localities in the following 12 counties: Surry, Rowan, Buncombe, Catawba, Henderson, McDowell, Orange, Polk, Rockingham, Vance, Warren, and Gaston, given in the order of the importance of their productions. Rowan County, which had the largest number of operators (10), was only second in the value of its production. In 1902 Rowan County, with 12 operators, was first in the value of the production. Gaston County, with 2 operators, was lowest in the value of its production, as it was also in 1902, when there were 5 producers. Surry County, in which are located the celebrated Mt. Airy quarries, produced the greatest value of granite. A little over one-third of the granite produced in the State during 1903 was used for building and monumental purposes, which is a decrease of \$40,153, as compared with the value of the granite used for the same purposes in 1902. There was a considerable increase in the value of the granite used for road-making and railroad ballast, the total value of the granite used for these purposes being \$102,524, an increase of \$24,765, as compared with \$77,759, the value of the production used for these same purposes in 1902. In the table below are given the different purposes for which the granite quarried in 1901, 1902 and 1903 was used.

**USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901,
1902 AND 1903.**

USES.	1901.	1902.	1903.
Building and monumental purposes	\$ 108,574	\$ 167,639	\$ 127,486
Paving blocks	10,662	6,986	30,780
Curbing and flagging	56,245	82,615	68,099
Crushed stone for road-making, railroad ballast, etc.	89,425	77,759	102,524
Other purposes		3,750	5,468
Total value	\$ 264,906	\$ 338,749	\$ 334,357

SANDSTONE.

Production.

Although there are good deposits of sandstone occurring in Anson, Moore, Chatham, Durham and Wake counties, this industry has always been small in North Carolina. In 1903 the production of sandstone had decreased to a value of but \$600, all of which was used for building purposes. This is a decrease of \$4,225, as compared with the value of the production of 1902, which was \$4,825, which in turn was a decrease of \$6,857, as compared with the production of 1901, which was valued at \$11,682.

MARBLE AND OTHER FORMS OF LIMESTONE.

Besides the interest in the marble and limestone deposits in North Carolina to be utilized for building purposes, considerable interest has been shown during the past year regarding these deposits as to the possibility of utilizing them in the manufacture of Portland cement. A number of inquiries have been received from parties outside the State for suitably located deposits of limestone with adjoining clay deposits or of marl deposits which occurred in sufficient quantity to warrant the establishment of a Portland cement manufacturing plant. During the past ten years a very great advance has been made in the utilization of cement in construction work, and this use has not only greatly increased the demand for Portland cement, but also the demand for deposits of the crude materials that are suitable for its manufacture. For this reason attention is called to the various de-

posits of limestone, marble, shale rock, marl, etc., that are known to occur in the State, with the idea that these deposits may be more thoroughly prospected and developed to prove their extent and the possibility of their utilization for the manufacture of Portland cement. It may also stimulate prospecting of new localities where there is a possibility of locating suitable deposits for this purpose.

The limestone deposits of the State should also be more thoroughly utilized for the burning of lime than they are at the present time, for by far the larger proportion of the lime used in North Carolina is imported from other States, principally from Tennessee and Virginia. The manufacture of lime from North Carolina limestones offers a promising field of investment, as the demand for lime is sure to keep pace with the increase in building and construction work; and there should be a good market for all that would be manufactured in the State. The occurrences of limestone in North Carolina are somewhat varied and widely separated in respect to locality. The deposits occurring in the southeastern counties are more or less admixed with clay and resemble marl. In other sections of these same counties it occurs in the form of a shell rock, such as the deposits that occur on the Northeast Cape Fear, Trent, and other rivers. In still other places it is to be found of a more compact nature, and forming fine-grained limestone rock which, however, has scattered through it here and there fossil shells which are more or less distinct in outline. This limestone rock often grades into a typical shell rock. These shell limestones are found in nearly horizontal beds in the coastal plain formation and are being used to some extent for building purposes, for road, and for harbor improvements. It is easily quarried and hardens sufficiently on exposure to the air to be very serviceable and makes a durable stone for rough, massive work.

The shell rock which occurs on the Northeast Cape Fear river opposite Rocky Point, Pender County, was employed about 14 years ago quite extensively for harbor improvements about Wilmington. This rock is overlain by 1 to 5 feet of soil and marl. Another use that has been made of this particular shell rock is in burning it to lime for agricultural purposes. It contains in certain portions of the rock small nodules of phosphate of lime. To the south of Rocky Point, at Castle Hayne, New Hanover County, there is a similar occurrence of

shell rock. The marls overlying these rocks, as well as the shell rocks themselves, have been, during the past year, investigated as to their value in the manufacture of Portland cement.

The shell rock that occurs on Trent river in Craven County is somewhat open in texture and has been used locally for rough building purposes and finished walls. The rock is composed of medium to large sized shells with an admixture of sand, the whole being cemented together with a carbonate of lime. This shell rock forms a durable building material and it can be easily quarried and brought to New Bern on flat-boats.

In the vicinity of Raleigh, Wake County, the limestone has been quarried to some extent, principally for burning to lime. These deposits are worthy of more thorough development and investigation.

In the piedmont counties there are several localities that contain limited deposits of a semi-crystalline limestone, notably those near Germantown, which is along the limestone belt that passes through Catawba, Lincoln, and Gaston counties. The deposits to the south of Bessemer City, Gaston County, offer possibilities of some promise as a suitable location for the manufacture of lime. In the western counties limestone is found in considerable quantities in Henderson, Transylvania, and Madison counties. The limestone in these counties has been utilized to some extent for burning to lime, but it has never been undertaken on a commercial scale, although the limestone makes a good quality of lime of a good white color. In the southern part of Transylvania County, the limestone becomes more siliceous and makes but an impure lime. In Henderson County the principal limestone beds lie about 7 to 10 miles west of Hendersonville in the vicinity of Boilston. In Madison County, limestone of fair quality is found in the vicinity of Hot Springs.

Extensive deposits of marble are found in Swain and Cherokee counties, and in the latter the deposits have been quite extensively developed by the National Marble Company of Murphy, North Carolina. They have taken out a very good quality of a blue-black and blue and white marble which makes a very handsome decorative and monumental stone. It can be obtained in large blocks for columns for building purposes and for shafts for monumental purposes. Its color is very good and this stone should find a ready market. White

and pink marble also occur to some extent in this same belt. In Swain County, on the property of Mr. Frank H. Hewitt, of Asheville, N. C., there is a large deposit of marble which is suitably located for quarrying and for railroad transportation. In McDowell County, about 10 miles north of Marion, there is a dolomitic marble which, while usually of a white color, is occasionally distinctly blue. Portions of this stone are well suited for building or ornamental purposes. Nearly all of these marbles would burn to an excellent lime, and, as nearly all the lime used in North Carolina is imported, the waste product obtained in quarrying could be utilized for this purpose and probably with very good financial results.

Production.

There was a production of marble from the Cherokee County deposits by the National Marble Company, which was used for building and monumental purposes, and judging from the work that is being done by this company and the quality of the marble that they are putting on the market, this is but the beginning of an industry that will become of some considerable importance in North Carolina.

The total production of marble and other forms of limestone in North Carolina during 1903 was valued at \$25,365, which is an increase of \$2,212 as compared with the production for 1902, which was valued at \$23,153. The larger proportion of the production was used for road-building and curbing. This production was obtained from Cherokee, New Hanover, and Pender counties, there being no production from Henderson County, which was one of the producers in 1902.

SLATE.

Slate of good quality is known to occur in the vicinity of Egypt, Pittsboro and Goldston, Chatham County, and near Albemarle, Stanly County. It has also been found in Durham and Alamance counties, but its actual value has not yet been determined. Near Mt. Gilead, Montgomery County, a slate quarry is being developed by Mr. J. J. Dun. The deposit, however, is 7 miles from the railroad.

CLAY.

There was a decided increase in the value of the production of clay products, including kaolin, in 1903 over the value of the production of 1902. The value of the 1903 production was \$942,458 as compared with \$908,105 during the previous year, being an increase of \$34,353. The value of the clay products, with the exception of kaolin, in 1903 was \$866,458, which is an increase of \$66,458 as compared with the value of the production of \$800,000 in 1902. This shows a decided increase in the clay industry, but it does not begin to represent the value of what the clay industry could and should be in North Carolina. There should be a much larger increase in the production of clay products, as there are good deposits of clay scattered throughout the State suitable for the manufacture of building brick of good quality that would stand transportation; for decorative brick; and for the manufacture of earthenware, sewer-pipe, terra-cotta, etc. At the present time a large proportion of the better grade of brick used in North Carolina is imported, and this is also true of a great deal of the earthenware, sewer-pipe, terra-cotta, etc.

KAOLIN OR CHINA-CLAY.

Kaolin deposits are known to occur in Jackson, Macon, Swain, and Buncombe counties. The best quality of kaolin, however, is that obtained from Jackson County, and that county has produced by far the largest quantity of any county in the State.

The American Land and Development Company are developing a deposit of kaolin near Barber's Creek Station, Jackson County, N. C., which is on the Asheville and Murphy branch of the Southern Railway. The deposit has been developed by a series of cross-cuts, pits and shafts which indicate that the clay occurs in considerable quantity and it is of good quality. This clay has been analyzed by Mr. F. F. Hunt, of 77 Pine Street, New York City, with the following results:

ANALYSIS OF KAOLIN FROM BARBER CREEK, JACKSON COUNTY.

	PER CENT.
Silica	44.66
Alumina	39.90
Iron	Trace
Alkalies	.68
Moisture	14.28
Total	99.52

In commenting on a sample of this clay sent to the American Encaustic Tiling Company, of Zanesville, Ohio, their superintendent, Mr. George A. Stanbery, made the following statement:

From the small sample sent us, we took 3 pounds of the clay and heaped it up, passing it through a No. 12 lawn. Twenty-five and one-half ounces of the clay went through the lawn and 22½ ounces refused to go through, which represents the waste. From the appearance of the sample, it looks as if the clay was very good. It shows white.

A fine clay that would furnish large quantities and of the same quality as the small sample sent would be valuable not only in our business, but to the white-ware potters. This clay is similar to that mined by the Harris Clay Company, which is the finest kaolin obtained in the United States.

There are a number of localities in the mountainous sections of North Carolina where kaolin occurs in small quantity, but as the feldspar from which the kaolin has been derived has been decomposed and altered to but a slight depth, these deposits of kaolin are soon worked out and the partially decomposed feldspar is encountered, which does not have the kaolin properties. Occasionally portions of the pegmatitic dike will be decomposed to a much greater depth than other portions and the kaolin will occur in bunches or pockets.

Nearly all of the kaolin that is mined in the State is shipped to the potteries at Trenton, N. J., or East Liverpool, Ohio, where it is utilized for those purposes which require the finest grade of clay. It is used in the manufacture of tiling; for the better grades of porcelain, and for the enamelling of brick. All those materials and others, such as electric porcelain insulators, etc., are imported into the State and sometimes have been made of the clay that has been exported. There should be a profitable investment in the utilization of these kaolins and similar clays for the manufacture of electric

porcelain insulator goods and pottery, all of which are now being imported into the State. In many sections we have the clay, the quartz and the feldspar required for the manufacture of these various clay products; and also good water-power that could be utilized in manufacturing them.

Production.

In 1903 all of the production of kaolin in the State was from Jackson County. Swain and Buncombe, which reported small productions in 1902, made none in 1903. The total quantity of kaolin mined in 1903 was 8,605 tons, valued at \$76,000, which is a decrease of 4,717 tons in quantity and of \$32,105 in value as compared with the production in 1902 of 13,322 tons, valued at \$108,105. The average value per ton of the 1903 production was \$8.83, which is an increase of 72 cents per ton as compared with the average value of \$8.11 per ton of the 1902 production.

POTTERY-CLAY.

Production.

There was a slight falling off in the value of the production of pottery in North Carolina during 1903, and the total value of this production of red earthenware and stoneware was only \$14,312, which is a decrease of \$200 as compared with \$14,512, the value of the production of 1902. There were 23 pottery manufacturers who aided in this production, and these were located in the following 8 counties, given in the order of the importance of their productions: Lincoln, Catawba, Buncombe, Chatham, Randolph, Wilkes, Union, and Jackson. In 1902 there were 28 pottery manufacturers located in the same 8 counties. There was no decorative ware reported as having been made in 1903. Of the 1903 production, \$612 was the value of the red earthenware, and \$13,700 of the stoneware. With improved methods and by exercising more care in the manufacture, and by using better material for glazing the ware, North Carolina potters would be able to put a far better grade of pottery on the market with but little or no more expense, and this would sell at a considerably increased price. The values of the different grades of pottery produced in the various counties during 1901, 1902 and 1903 are given in the following table:

**VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA
BY COUNTIES IN 1901, 1902 AND 1903**

COUNTY.	1901				1902				1903			
	PARTHEN WARE.	STONE WARE.	DRUMMA TIVE WARE, ETC.	TOTAL.	PARTHEN WARE.	STONE WARE.	TOTAL.		PARTHEN WARE.	STONE WARE.	TOTAL.	
Burke	\$ 250	\$ 1,100	\$ 1,000	\$ 2,350	\$ 150	\$ 1,800	\$ 1,950	\$ 40	\$ 2,200	\$ 1,500	\$ 3,700	
Catawba	2,500	2,500	2,500	7,500	35	4,425	4,460		2,125	2,125	4,250	
Chatham		2,700		2,700		2,700	2,700		2,000		2,000	
Cum gratia	50			50								
Johnston	125	1,700		1,825	40	525	565	50	200	2,200	2,400	
Lenoir	2,300	2,700	25	5,025	25	2,300	2,325	100	2,425			
Rutherford	50	1,175	200	1,525	25	75	100	100	1,000			
Union	225	1,500	25	1,750	200	300	500	100	400			
Warren			200	200								
Wilson		1,200		1,200	50	1,100	1,150	50	1,150			
Total	\$ 4,000	\$ 17,625	\$ 542	\$ 22,167	\$ 650	\$ 12,550	\$ 13,200	\$ 622	\$ 12,700	\$ 14,312	\$ 27,012	

FIRE-CLAY AND PIPE-CLAY.

Production.

There was a very decided increase in the production of fire-clay and pipe-clay products during 1903, and this increase was for the most part in connection with the manufacture of tiling and the better grades of sewer-pipe. The total value of all fire-clay and pipe-clay products reported in 1903 was \$107,114, this including fire-brick, fire-clay sold crude, sewer-pipe, tile, etc. This is an increase of \$33,975 in value as compared with \$74,036, the value of the production of 1902. This in turn was an increase of \$16,576 in value as compared with the value of the production of 1901, which was \$56,395. This continued increase in the production of these clay products illustrates what can be accomplished in the manufacture of the better grade of clay products, but this production should increase many times more, as the demand for these products in the State fully warrants this.

Of the 1903 production, \$5,250 was the value of 407,500 fire-brick, which is an increase of 322,500 fire-brick in quantity and of \$4,047 in value as compared with the production of 1902 of 85,000 fire-brick, valued at \$1,203. There was also a small amount of crude fire-clay sold in 1903, amounting to 231 tons, valued at \$875. In 1902 the value of the crude fire-clay sold was \$215.

The most noticeable increase in the production of these clay products was sewer-pipe, tile, etc., whose value in 1903 was \$107,114, which is an increase of \$34,496 as compared with \$72,618, the value of the production in 1902. This in turn was an increase of \$16,873 as compared with \$55,745, the value of the production in 1901. Although there has been this decided increase since 1901, the production does not begin to represent the increase that there should be in this industry in North Carolina.

BRICK-CLAY.

There are clay deposits suitable for the manufacture of brick occurring in the greater number of counties throughout North Carolina, and in a number of these the clay is of such quality that it is capable of being used in the manufacture of pressed brick, front brick or decorative brick, which should find a ready market throughout the State and also in adjoining States. In order, however, to utilize these clays for this purpose, more attention will have to be given to details in the manufacturing of the brick than is being done at the present time in order to put a better made brick on the market, and one which is not only more attractive in appearance, but also capable of standing transportation and rough handling. While there is but little margin of profit in the manufacture of the cheaper grades of brick, there is a good margin of profit in the manufacture of the better quality of bricks, such as pressed brick and decorative brick. Contractors throughout the State are constantly attempting to utilize for the manufacture of brick clays found in the vicinity of where they are erecting buildings; and often the bricks that are made will hardly hold together long enough to be laid during the course of the construction of the building. In a number of instances brick that were being used in the construction of public as well as private buildings have been examined, which, if there had been any inspector of buildings, would have been thrown out as totally unfit for any use in construction. It is not always the fault of the clay that such poor brick are made, but due to the poor methods used in the manufacture of the brick and often to the unskilled labor employed.

Production.

During 1903 brick were manufactured in 62 counties, which is 5 less than in 1902. Seven counties, Franklin, Granville, Hertford, Person, Vance, Warren, and Yadkin, which reported a production of brick during 1902, reported none in 1903, while Ashe and Jackson counties, which made no production in 1902, were producers of brick in 1903. The total number of all kinds of brick, except fire-brick, made during 1903 amount to 138,088,900, valued at \$745,032, this being an average value of \$5.39 per thousand. This production is an increase of 4,537,200 brick in quantity and of \$33,580 in value as compared with the production of 133,551,700 brick; valued at \$711,452 in 1902.

Of the 1903 production there were 136,822,900 common brick, valued at \$731,802, which is an increase of 5,211,200 brick in quantity and of \$36,975 in value as compared with the production of 131,611,700 common brick, valued at \$694,827, in 1902. The number of pressed brick manufactured in 1903 were 766,000, valued at \$8,230, and of vitrified brick, 500,000, valued at \$5,000. In the table below are given the quantity and value of the common, pressed and vitrified brick produced in 1901, 1902 and 1903:

PRODUCTION OF COMMON, PRESSED, VITRIFIED AND FIRE-BRICK
IN 1901, 1902 AND 1903.

CHARACTER.	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick.....	134,441,570	\$697,861	131,618,700	\$694,827	136,822,900	\$ 731,802
Pressed brick.....	1,096,000	10,220	1,833,000	10,625	766,000	8,230
Vitrified brick.....	180,000	1,650	600,000	6,000	500,000	5,000
Fire-brick.....	55,000	550	120,000	1,203	407,500	5,250
Total.....	135,771,570	\$710,281	134,171,700	\$712,655	138,496,400	\$ 750,282

There was also a slight increase in the average value per thousand of the 1903 production as compared with the average value of \$5.33 per thousand of the 1902 production, this being an increase of 6 cents per thousand. As compared with the 1901 production the increase in the average value per thousand is 16 cents, the average

received in 1901 being \$5.23 per thousand. The number of makers engaged in making brick during 1903 was 171, which is less than the number (195) engaged in this business in 1902. The number of kilns was 36 less than the number (231) in 1901. The lowest price per thousand reported as having been received for brick during 1903 was \$3.50 and the highest \$10, this latter value being for vitrified brick, as compared with \$3.75 and \$10, which were the lowest and highest prices received respectively for brick during 1902. The lowest price reported as having been received for common brick per thousand, the same as reported in 1902. This value was given for a small production made in Washington County. The following tables are given the total number and value of the different varieties of brick, including fire-brick, manufactured in North Carolina during 1903 by counties:

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1903 BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE- BRICK.	VALUE.
Adams	2,750,000	\$ 15,250		\$		\$
Ashe	1,000,000	5,500				
Beaufort	300,000	1,500				
Bertie	1,323,000	8,200				
Bladen	4,600,000	21,000				
Chatham	200,000	1,100				
Cherokee	4,305,900	22,686	150,000	2,250	365,500*	5,100
Catawba	400,000	1,600				
Cabarrus	5,010,000	25,055	100,000	1,000		
Caldwell	1,500,000	5,250				
Camden	150,000	900				
Carteret	1,920,000	9,680				
Catawba					2,000†	20
Chatham	1,000,000	7,000				
Cherokee	975,000	5,320	200,000	2,000		
Chatham	2,000,000	10,000				
Catawba	6,000,000	47,750				
Catawba	1,750,000	9,500				
Catawba	500,000	2,500				
Catawba	50,000	278				
Catawba	6,710,000	36,210				
Catawba	5,450,000	32,700				
Catawba	8,505,000	44,625	150,000	1,500		
Catawba	2,670,000	14,350				
Catawba	105,000	375				
Catawba	635,000	4,445				

**NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA
IN 1903 BY COUNTIES—CONTINUED.**

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE BRICK.
Guilford	8,188,000	\$ 44,817			
Halifax	3,400,000	19,500	70,000	600	
Harnett	2,500,000	10,800			
Haywood	700,000	3,990			
Henderson	1,000,000	5,000			500,000
Iredell	3,200,000	15,900			
Jackson	70,000	420			
Johnston	1,730,000	10,350			
Lenoir	1,000,000	6,500			
Lincoln	830,000	4,150			
McDowell	2,900,000	14,500			
Martin	8,000	48			
Mecklenburg	2,300,000	14,000			
Montgomery	282,000	1,403			
Moore	2,682,000	13,687			
Nash	1,000,000	5,500			
New Hanover	2,750,000	16,500			
Orange	1,000,000	4,950			30,000
Pasquotank	1,800,000	10,800			
Pitt	1,240,000	7,458			
Randolph	780,000	3,742			10,000
Robeson	352,000	2,103	14,000	124	
Rockingham	3,216,000	18,860			
Rowan	2,500,000	13,500			
Rutherford	650,000	3,340			
Sampeon	50,000	250			
Scotland	600,000	3,300			
Stanly	300,000	1,200			
Surry	1,210,000	5,755	50,000	500	
Transylvania	95,000	500			
Union	3,437,000	15,555			
Wake	5,166,000	26,095			
Washington	30,000	240			
Wayne	9,150,000	51,075			
Wilkes	1,598,000	7,990	32,000	256	
Wilson	6,300,000	35,250			
Total	136,822,900	\$ 731,802	766,000	\$ 8,230	907,500

*Vitrified brick.

†Fire-brick.

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA
DURING 1902.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Alamance	5,220,000	\$ 24,075		\$		\$
Anson	600,000	3,500				
Beaufort	1,440,000	9,000				
Bertie	3,616,000	18,635	500,000	4,000		
Bladen	400,000	2,000				
Buncombe	4,750,000	23,978				
Burke	1,700,000	6,800				
Cabarrus	85,000	425				
Caldwell	1,260,000	5,720				
Carteret	990,000	500				
Catawba	477,000	2,072				
Chatham	100,000	500				
Chowan	1,000,000	7,000				
Cleveland	1,258,000	6,148				
Columbus	1,200,000	6,000				
Craven	4,500,000	22,500				
Cumberland	3,000,000	15,000				
Davidson	2,320,000	13,000				
Duplin	263,700	1,458				
Durham	5,050,000	25,825				
Edgecombe	4,050,000	23,500				
Forsyth	3,442,000	15,423				
Franklin	200,000	1,400				
Gaston	1,725,000	7,845				
Gates	105,000	430				
Granville	800,000	6,000				
Greene	910,000	5,478				
Guilford	8,802,000	44,160	240,000	1,900		
Halifax	4,050,000	23,500	175,000	1,575		
Harnett	2,400,000	9,900				
Haywood	400,000	2,200				
Henderson	1,000,000	6,000	30,000	450	600,000	6,000
Hertford	140,000	880	140,000	880		
Iredell	1,500,000	8,050				
Johnson	570,000	3,600				
Lenoir	3,000,000	18,500				
Lincoln	300,000	1,500				
McDowell	900,000	5,300				
Martin	19,000	105				
Mecklenburg	2,765,000	14,418				
Montgomery	300,000	1,500	80,000	650		
Moore	1,650,000	7,200				
Nash	2,000,000	11,000				
New Hanover	1,000,000	5,500				
Orange	370,000	1,630				
Pasquotank	1,650,000	9,575				
Person	6,000,000	36,000				
Pitt	1,728,000	11,122				
Randolph	1,590,000	7,550				
Robeson	625,000	3,780				
Rockingham	4,447,000	22,267				
Rowan	1,800,000	10,500				
Rutherford	200,000	850				
Sampson	100,000	500				

**NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA
DURING 1902—CONTINUED.**

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Scotland	500,000	\$ 2,500	-----	\$ -----	-----	\$-----
Stanly	500,000	2,570	-----	-----	-----	-----
Surry	1,115,000	5,955	-----	-----	-----	-----
Transylvania	600,000	3,000	-----	-----	-----	-----
Union	900,000	4,685	-----	-----	-----	-----
Vance	100,000	700	-----	-----	-----	-----
Wake	5,215,000	26,573	50,000	450	-----	-----
Warren	100,000	500	-----	-----	-----	-----
Washington	160,000	1,100	-----	-----	-----	-----
Wayne	13,850,000	70,350	-----	-----	-----	-----
Wilkes	1,325,000	6,380	115,000	690	-----	-----
Wilson	8,333,000	48,950	-----	-----	-----	-----
Yadkin	53,000	265	33,000	30	-----	-----
Total	131,618,700	\$694,827	1,333,000	\$ 10,625	600,000	\$ 6,000

As is seen from the above table of the production of brick in 1903, of the 97 counties in North Carolina only 62 reported any production of brick. The county to produce the largest number of brick in 1903 was Wayne, whose production was 9,150,000, valued at \$51,075. This county was also the largest producer in 1902, when its production amounted to 13,850,000, valued at \$70,350, this being 4,700,000 more than in 1903. Forsyth County was second in 1903, with a production of 8,655,000 brick, valued at \$46,125. Guilford County, which was second in 1902, with a production of 9,042,000, valued at \$46,060, was third in 1903, with a production of 8,188,000 brick, valued at \$44,817. The county producing the smallest number of common brick was Martin, which reported a production of only 8,000, valued at \$48. This county was also the smallest producer in 1902, when the production reported amounted to 19,000 brick, valued at \$105. There is given in the table below the quantity and value of all the clay products produced in North Carolina in 1901, 1902 and 1903. The above statistics regarding the clay production of the State does not, perhaps, represent the output in its entirety, for the reason that in a number of the mountain counties there are a few thousand brick occasionally made for local purposes, regarding which it is difficult or impossible to obtain any statistics.

**VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN
1901, 1902 AND 1903.**

	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick-----	134,441,570	\$697,861	131,611,700	\$694,827	136,822,900	\$ 731,802
Pressed brick-----	1,095,000	10,220	1,233,000	10,625	766,000	8,230
Vitrified brick-----	180,000	1,650	600,000	6,000	500,000	5,000
Fire-brick-----	55,000	550		1,203	407,500	5,250
Earthenware-----		4,490		658		612
Stoneware-----		17,453		13,854		13,700
Decorated ware-----		552				
Sewer-pipe, tile, etc.		55,745		72,618		100,989
	TONS.		TONS.		TONS.	
Kaolin-----	15,575	119,172	13,322	108,105	8,605	76,000
Fire-clay-----		100		215	231	875
Total value-----		\$907,793		\$908,105		\$ 942,458

In the following table there is given the total mineral production of the State for the years 1900 to 1903, inclusive:

**THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS
1900, 1901, 1902 AND 1903.**

MINERAL.	VALUE.			
	1900.	1901.	1902.	1903.
Gold-----	\$ 46,653	\$ 60,411	\$ 93,650	\$ 113,604
Silver-----	15,986	34,024	30,212	16,907
Copper-----	41,600	76,900	212,553	67,037
Iron-----	42,000	4,997	52,771	78,540
Pyrite-----	14,625	32,000		
Garnet-----	18,000	43,000	10,040	12,250
Corundum-----	36,840	48,840		
Millstones-----			1,425	902
Mica { Sheet-----	65,200	79,849	81,653	86,300
Scrap-----	36,262	14,200	2,919	2,400
Quartz-----		7,500	11,250	36,827
Precious stones-----	12,020	24,245	5,300	1,525
Rare minerals-----			60	270
Monazite-----	48,805	59,262	64,160	58,694
Zircon-----			360	570
Barytes-----		22,615	44,130	21,347
Talc and pyrophyllite-----	42,000	77,974	88,962	76,984
Graphite-----		559	4,300	248
Coal-----	22,500	5,585	24,500	25,300
Stone-----	285,172	284,744	366,727	360,322
Kaolin-----	62,440	119,172	108,105	76,000
Clay products-----	815,975	788,618	800,000	866,458
Total value-----	\$1,604,078	\$1,779,109	\$2,003,077	\$ 1,902,485

As is seen from the above table, there was a slight falling off in the total value of \$1,902,485 of the mineral production for 1903 compared with that of \$2,003,077 for 1902, this decrease amounting to \$100,592. There were 78 counties of the 97 in the State from which the mineral production of 1903 was obtained, and in the following table the value of the production for each county is given. The value of the clay products, with the exception of kaolin, which is included with the other minerals, is given separately from the rest of the mineral production.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1902 AND 1903.

COUNTY.	1902.			1903.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Alamance	\$-----	\$24,075	\$ 24,075	\$-----	\$ 15,250	\$ 15,250
Alexander	200	-----	200	50	-----	50
Alleghany	-----	-----	-----	-----	-----	-----
Anson	-----	4,250	4,250	600	5,500	6,100
Ashe	-----	-----	-----	1,000	1,500	2,500
Beaufort	-----	9,500	9,500	-----	8,200	8,200
Bertie	-----	22,653	22,653	-----	21,300	21,300
Bladen	-----	2,018	2,018	-----	1,100	1,100
Brunswick	-----	-----	-----	-----	-----	-----
Buncombe	18,375	27,463	45,838	14,566	32,371	46,937
Burke	10,238	6,800	17,038	12,629	1,600	14,229
Cabarrus	10,650	425	11,075	3,323	26,055	29,378
Caldwell	19	5,720	5,739	42	5,250	5,292
Camden	-----	-----	-----	-----	-----	-----
Carteret	-----	500	500	-----	900	900
Caswell	-----	-----	-----	-----	-----	-----
Catawba	8,336	6,562	14,898	7,060	12,835	19,895
Chatham	24,630	2,500	27,130	27,523	2,000	29,523
Cherokee	21,952	-----	21,952	50,116	-----	50,116
Chowan	-----	7,000	7,000	-----	7,020	7,020
Clay	200	-----	200	297	-----	297
Cleveland	16,000	6,148	22,148	19,969	7,320	27,289
Columbus	-----	6,000	6,000	-----	10,000	10,000
Craven	-----	22,500	22,500	-----	47,750	47,750
Cumberland	19	15,000	15,019	-----	9,500	9,500
Currituck	-----	-----	-----	-----	-----	-----
Dare	-----	-----	-----	-----	-----	-----
Davidson	27,971	13,000	40,971	672	2,500	3,172
Davie	-----	-----	-----	-----	-----	-----
Duplin	-----	1,458	1,458	-----	278	278
Durham	-----	25,825	25,825	-----	36,210	36,210

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH
CAROLINA IN 1902 AND 1903—CONTINUED.

COUNTY.	1902.			1903.		
	MINERAL PRO- DUCTION, INCLUD- ING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRO- DUCTION, INCLUD- ING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Edgecombe	\$	\$ 23,500	\$ 23,500	\$	\$ 32,700	\$ 32,700
Forsyth	3,057	15,623	18,680		46,401	46,401
Franklin	632	1,400	2,032	165		165
Gaston	8,874	7,845	16,719	1,112	14,350	15,462
Gates		430	430		375	375
Graham						
Granville	3,996	6,000	9,996	5,477		5,477
Greene		5,478	5,478		4,445	4,445
Guilford	968	117,560	118,528	3,966	144,817	148,783
Halifax	1,356	25,075	26,431	426	20,100	20,526
Harnett		9,900	9,900		10,800	10,800
Haywood	20,850	2,200	23,050	18,560	3,990	22,550
Henderson	16,201	12,450	28,651	17,589	10,800	28,389
Hertford		1,760	1,760			
Hyde						
Iredell	434	8,050	8,484	160	15,900	16,060
Jackson	119,905		119,905	94,646	420	95,066
Johnston	475	4,165	4,640	15,000	10,685	25,685
Jones						
Lenoir		18,500	18,500		6,500	6,500
Lincoln	9,845	4,425	14,270	15,256	7,520	22,776
McDowell	42,715	5,300	48,015	34,690	14,500	49,190
Macon	6,344		6,344	3,749		3,749
Madison	42,630		42,630	26,447		26,447
Martin		105	105		48	48
Mecklenburg	21,300	14,418	35,718	8,682	14,000	22,682
Mitchell	79,319		79,319	93,127		93,127
Montgomery	39,173	2,150	41,323	49,513	1,403	50,916
Moore	13,937	7,200	21,137	7,769	13,687	21,456
Nash	299	11,000	11,299	142	5,500	5,642
New Hanover	21,063	5,500	26,563	20,400	16,500	36,900
Northampton						
Onslow						
Orange	5,462	1,648	7,110	27,781	4,980	32,761
Pamlico						
Pasquotank		9,575	9,575		10,800	10,800
Pender	470		470	600		600
Perquimans						
Person	157,010	36,000	193,010	71,316		71,316
Pitt		11,122	11,122		7,458	7,458
Folk	1,339		1,339	7,507		7,507
Randolph	1,076	8,547	9,623	403	5,797	6,200
Richmond						
Robeson		3,780	3,780		2,227	2,227
Rockingham		22,267	22,267	10,200	18,860	29,060
Rowan	187,777	10,500	198,277	112,573	13,500	125,073
Rutherford	18,269	850	19,119	12,344	3,340	15,680
Sampson		500	500		250	250
Scotland		2,500	2,500		3,300	3,300

**VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH
CAROLINA IN 1902 AND 1903—CONTINUED.**

COUNTY.	1902.			1903.		
	MINERAL PRO- DUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRO- DUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Stanly -----	\$ 867	\$ 2,570	\$ 3,437	\$ 24,640	\$ 1,200	\$ 25,840
Stokes -----	1,000	-----	1,000	7,740	-----	7,740
Surry -----	116,965	-----	116,965	111,462	6,255	117,717
Swain -----	74,187	-----	74,187	53,150	-----	53,150
Transylvania -----	780	3,100	3,880	516	500	1,016
Tyrrell -----	-----	-----	-----	-----	-----	-----
Union -----	754	5,285	6,039	3,198	16,055	19,253
Vance -----	17,554	700	18,254	\$14,750	-----	14,750
Wake -----	9,200	27,023	36,223	248	26,095	26,343
Warren -----	121	500	621	751	-----	751
Washington -----	-----	1,100	1,100	-----	240	240
Watauga -----	-----	-----	-----	-----	-----	-----
Wayne -----	-----	70,350	70,350	-----	51,075	51,075
Wilkes -----	-----	8,220	8,220	-----	9,396	9,396
Wilson -----	-----	48,950	48,950	-----	35,250	35,250
Yadkin -----	-----	295	295	-----	-----	-----
Yancey -----	22,159	-----	22,159	20,600	-----	20,600
Unknown -----	1,030	-----	1,030	1,525	-----	1,525
Total value.	\$1,203,077	\$800,000	\$2,003,077	\$868,458	\$1,036,027	\$ 1,902,485

Of the 78 counties reporting a mineral production for 1903, there were only 48 counties that reported anything besides clay products. There were 62 counties reporting a production of clay, of which 29 counties did not report any other mineral production. There were 14 counties reporting a mineral production, but none of clay products. The number of counties producing both clay and other mineral products was 34. There were 19 counties that did not report the production of any mineral whatever during 1903. The county reporting the greatest value for its mineral production, except clay products, was Rowan, the value being \$112,573. The county producing the greatest value of clay products was Guilford, the value being \$144,817. The county whose total mineral production was greatest in value in 1903 was Guilford, the value being \$148,783. Rowan County is second in the valuation with a production valued at \$125,073. The lowest value reported by any county was \$48, which was the value of the mineral production of Martin County.

PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building Stone in North Carolina, by Joseph A. Holmes, George P. Merrill and T. L. Watson. *In preparation.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Out of print.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Out of print.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Out of print.*
8. Water powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. Mica Deposits and Mica Mining in North Carolina, by Joseph A. Holmes. *In preparation.*
15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*
16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*
17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*
18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1904. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS.

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*
2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

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no. 9

THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper No. 9

THE MINING INDUSTRY

IN

NORTH CAROLINA DURING 1904

BY

JOSEPH HYDE PRATT, PH. D.

MINERALOGIST



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273891

LETTER OF TRANSMITTAL.

RALEIGH, N. C., August 15, 1905.

To *his Excellency*, HON. R. B. GLENN,
Governor of North Carolina.

SIR:—I herewith have the honor to submit for publication as Economic Paper No. 9, a report on the Mining Industry in North Carolina for the year 1904. In this report are taken up the statistics of production of the various minerals that were mined in the State during 1904; it also gives full descriptions of the occurrence of some of the minerals which have not been described before, and also calls attention to new deposits that may be of economic importance.

I am, with great respect,

Yours very truly,

J. A. HOLMES,
State Geologist.



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built for treating the same. Thus, the Whitney Company, of Salisbury and Gold Hill, Rowan County, who have, by their development work, blocked out a very large body of ore, have treated but little of their ore, and are holding this until the completion of their operations at the Narrows of the Yadkin, where will be erected their reduction plant.

Of the two minerals for which North Carolina is especially noted, mica and monazite, there was a decided increase in the value of the productions of 1904 over that of 1903; while with the iron and copper ores and talc and soapstone there was a corresponding decrease in the value of the production. The stone industry, which plays a very important part in the mining industry of North Carolina, showed a slight falling off in value during 1904.

The largest mineral industry in the State is the production of clay products, and for the past three or four years there has been a constant increase in the value of the production of these products in the State. Although there has been this increase in the value of the production, there has not been a corresponding increase in the methods of mining and manufacturing of the clay products which is warranted by the amount of these products used in the State. At the present time about one-half of the total mineral production of the State is of kaolin and other clay products.

The tin deposits of the State have attracted considerable attention during the past year and a bulletin has been published by the Survey descriptive of these deposits as Bulletin No. 19.

There are a number of new railroads or extensions that are being built in the State which will open up portions of counties containing considerable mineral wealth, as the road running from Erwin, Tennessee, to Spruce Pine, Mitchell County, and which is being vigorously pushed toward Marion, McDowell County; another is a continuation of the road from Johnson City, Tenn., to Cranberry, N. C., which has been extended to Kawana, Mitchell County; and a third is in the southern part of the State, which is an extension from Tallulah Falls, Ga., to Franklin, Macon County. This road has now reached the State line and grading has begun down the Little Tennessee River toward Franklin. All of these three railroads will cause the opening up of mineral deposits and timber lands and should result in an increased production of minerals and ores from these counties.

The total value of the mineral production of North Carolina during 1904 was \$1,946,273, as compared with \$1,902,485 in 1903, which is an increase of \$43,788. The minerals and ores that have been mined in North Carolina during 1904 are given below in the order in which they are discussed in the following pages: Gold and Silver, Copper, Iron, Tin, Abrasive Materials (Corundum, Garnet, Millstones), Mica, Quartz, Barytes, Monazite and Zircon, Rare Minerals, Tale and Soapstone, Precious Stones, Graphite, Coal, Stone, Kaolin and Clay Products.

GOLD AND SILVER.

There were over 400 localities in North Carolina that have been mined for gold and silver, and, while many of these have been worked to but a very limited extent, a number of them have been the scene of large mining operations or extensive development work. In 1904, the localities worked were situated in 34 different counties as compared to 31 counties in 1903. The additional counties in 1904 from which there was a production of gold and silver were Alamance, Anson and Chatham. Development work has been carried on extensively at a number of mines which made little or no production during 1904, but which have succeeded in blocking out large bodies of ore which can be mined cheaply and readily and will within the next year or two be producing gold on a large scale. This is true of the property of the Whitney Company, who are developing gold properties in the vicinity of Gold Hill, Rowan County. The largest production of gold was from Montgomery County, the Iola mine being the chief producer, while the largest amount of silver was obtained from Rowan County, which was also by far the largest producer of copper ores. The fineness of the North Carolina gold is very high, as is indicated by the very small amount of silver that is obtained alloyed with it in mining for gold. This is well indicated when it is considered that in Montgomery County there was over \$50,000 worth of gold produced, while the silver obtained from these gold ores only amounted to \$901 in value. Most of the silver is obtained as a by-product in copper mining, there being no mines in the State that are worked exclusively or primarily for silver. The bulk of the production of gold in North Carolina in 1904 was from Cabarrus, Catawba, Guilford, Montgomery, Stanly and Union counties; while the silver

was obtained principally from Rowan, Person and Granville counties, these latter three being also the counties from which the copper ores are obtained.

It is interesting to note the erection of the cyanide plants at the Colossus (Howie mine), the Southern Homestake mine of Randolph County, and at the Iola mine in Montgomery County. The latter is a 20-ton plant and has been adapted for treatment of tailings from the mill. The other two are of larger capacity. During 1904 there was but little opportunity to work these mills, so that the production by cyaniding was not very large, amounting to a little over \$7,000. A cyanide plant has also been erected at the Miami mine of Cabarrus County, which was not operated in 1904, but a chlorination plant was used which, for these ores, as far as could be learned, gave better satisfaction. The work that has been done on the various North Carolina ores in experimenting with the cyanide and chlorination processes has shown that many of the ores are very susceptible to the cyanide process and others can be more profitably treated by the chlorination process.

In mining gold and silver in North Carolina during 1904 three different systems were conducted: (1) ordinary mining by a system of shafts, drifts, tunnels, cross-cuts, etc.; (2) by operating placer deposits by ordinary hydraulic methods; and (3) by dredging certain of the river bottoms. This latter method added but little to the value of the production, the greater amount being obtained from deep mines, the ore from which was crushed and run through stamp mills. A certain amount of gold and nearly all the silver were obtained from the reduction of copper ores.

The principal properties from which most of the gold and silver were obtained during 1904 numbered 39, and were located in 18 different counties. In the table below there is given a list of these mines, and the counties in which they are located, for the years 1903 and 1904:

**PRINCIPAL MINES PRODUCING GOLD AND SILVER
DURING 1903 AND 1904.**

NAME OF MINE.	COUNTY.	YEAR.
.....	Cabarrus	1903—
ormerly Phoenix).....	Cabarrus	1903—1904
.....	Catawba	1903—1904
y.....	Cherokee	1903—
.....	Davidson	1903—1904*
g (a).....	Granville	1903—1904
.....	Franklin	1903—1904
er.....	Guilford	1903—1904*
.....	Guilford	1903—1904
.....	Guilford	1903—1904*
.....	Guilford	1903—1904
sh.....	Guilford	1903—
edge.....	Hallfax	—1904
ntain.....	McDowell	1903—1904*
ll.....	Mecklenburg	1903—1904
.....	Mecklenburg	—1904
rine.....	Mecklenburg	—1904
ill.....	Mecklenburg	1903—1904
ille or Wilhelmina.....	Mecklenburg	1903—1904*
.....	Montgomery	1903—1904
ry.....	Montgomery	1903—1904
.....	Montgomery	1903—1904
Merrill.....	Moore	1903—1904*
ington.....	Nash	1903—1904
(a).....	Person	1903—1904
.....	Person	1903—1904
.....	Person	1903—1904
.....	Polk	1903—1904
.....	Randolph	1903—
Stillwater.....	Randolph	1903—1904*
(a).....	Rowan	1903—1904
(formerly McMakin).....	Rowan	1903—1904
.....	Rowan	1903—1904
.....	Stanly	1903—1904
Crawford.....	Stanly	1903—1904
.....	Stanly	1903—1904
formerly Howie).....	Union	1903—1904
all (formerly Black).....	Union	1903—1904
.....	Union	1903—1904*

above table the names of the mines marked by (a) are cop-
 es from which the gold has been obtained as a by-product.
 isk after a certain year indicates that during that year the
 s worked but very little.

above mines, those marked with an (a) are copper mines,
 of which have furnished some gold and more silver as
 ets. The mines producing the greatest amount of gold
 er in 1904 are as follows, given in the order of the yield of
 oduction: The Iola, of Montgomery County; the Barringer

mine, of Stanly; the Union Copper Company's mine, of Rowan County; the Miami (formerly Phoenix), of Cabarrus; the Fentress, of Guilford; and the Colossus, of Union. The Fentress mine, of Guilford County, was operated a considerable part of 1904, up to the death of the manager. The mine is now being operated by the Guilford Mining Company.

The Miami mine, in Cabarrus County, was worked very vigorously in 1904, and the latest work is on the 425-foot level, where an 8-foot vein has been encountered.

The Barringer mine, in Stanly County, was worked during the early part of 1904, but was flooded on August 11th, and thus far there has been no indication of unwatering the mine and renewing the work.

The Colossus mine, in Union County, has also been worked quite extensively and has treated a considerable tonnage of tailings from previous mining. It has also done some underground development work. The Indian Trail mine, also in Union County, encountered a small but very rich vein, which was worked in a small way during 1904.

In Montgomery County the Iola was worked quite extensively during the year at the 250-foot level, and this is the most profitable mine at the present time in the State.

The Montgomery mine, which is near the Iola, is making arrangements for carrying on a considerable amount of development work, while prospecting is being done on the Golconda property adjoining.

In Mecklenburg County nothing of importance has been accomplished in gold mining during 1904. The re-opening and the development of the Rudisill and St. Catherine mines are proceeding very slowly, and but little has thus far been accomplished with these properties.

In Rutherford County the Wolverine Gold Mining Company are developing a property about 4 miles from Rutherfordton. A shaft has been sunk to the depth of 100 feet, which encountered a narrow vein, which assayed very well, its width averaging about 18 inches. The property acquired by this company is supposed to be the property that was worked a good many years ago by the Rutherford Gold Company, but no data can be obtained regarding the work done by this company. There was an old tunnel discovered on the property by the company, which they followed for a distance of 350 to 400 feet,

but on account of the cave-ins, they gave up following it further. It is known in the vicinity as the Bechtler tunnel, but no information could be obtained as to when it was made, or for what purpose. It starts in a southwest direction and then shortly turns abruptly to the west and then again to the northeast. It is approximately 10 feet wide and 8 feet high and cut through the country rock. As far as could be discerned, there is no vein material visible, but the walls of the tunnel were assayed and gave a value of \$1.40 per ton in gold. The company have equipped the property with the necessary machinery for carrying on their development work and for taking out ore.

There is an interesting property being developed in Surry County, in the vicinity of Elkin, on the property of Mr. R. N. Chatham. The vein can be traced for 500 or 600 feet and is prominently exposed in two stream-beds and outcrops at various places in this distance. Its trend is N. 55° E. It has been tested at a number of points and cross-cuts have been made at several places. Assays made of average samples of this ore gave \$15.80 and \$18.40 per ton. The location of this vein and the quality of the ore make this a very promising property for further development.

In Catawba County, at the Shuford mine, a large amount of work was done and the mining has been carried to the 60-foot level. In treating the ore no stamp-mills are used, but a centrifugal disintegrator from which the ore is fed to sluice-boxes, where the gold is collected.

In Halifax County, near Essex, the Farley dredge was operated a short time, making a small production of gold during the latter part of the year.

Most of the placer mining was in Burke, Cherokee, Clay, Cleveland, Halifax, Iredell, Lincoln, Macon, McDowell, and Warren counties, the production in all cases being small. In a number of them, as Burke, Cleveland, Iredell and Lincoln, which are counties producing a large amount of monazite, the gold was obtained as a by-product in the mining of monazite. In the following table is shown the sources of the production of gold and silver in North Carolina during 1904:

**SOURCES OF THE GOLD PRODUCED IN NORTH CAROLINA
DURING 1904.**

PROCESS.	GOLD.	SILVER.	TOTALS.
Chlorination works	\$ 1,162.83	\$	\$ 1,162.83
Cyanide works	7,273.84	151.68	7,425.52
Dredging	456.32	.84	457.16
Copper ore shipments	13,007.10	17,516.90	30,524.00
Placers	10,429.30	166.11	10,595.41
Stamp mills	90,116.53	1,246.20	91,362.73
Untraceable sources	1,478.08	50.85	1,528.93
Totals	\$ 123,924.00	\$ 19,132.58	\$ 143,056.58

PRODUCTION.

The total coining value of the production of gold and silver in 1904 was \$143,057, which is an increase of \$12,547 as compared with that of 1903, which was valued at \$130,510. Of this production \$123,924 was due to the value of the gold produced, an increase of \$10,320 as compared with \$113,604, the value of the 1903 production. The value of the silver produced was \$19,133 (coining value), as compared with \$16,907 in 1903, an increase of \$2,226. The production of gold and silver of 1904 was divided among 34 counties as compared with 31 counties in 1903, the new producing counties being Alamance, Anson and Chatham. The county producing the largest amount of gold was Montgomery, with a production valued at \$50,461, while the smallest productions were from Orange and Alamance Counties, each producing gold to the value of \$23.26. The county which was second in the value of its production of gold in 1904 was Stanly, with a value of \$17,114, while Cabarrus was third, with a value of \$14,890. Montgomery and Stanly were the first and second producers respectively of gold in 1903, while Mecklenburg was third. The production of silver was obtained chiefly from Rowan County, with considerably smaller amounts from Person and Granville Counties, these three representing copper mines which produced the silver as a by-product. Rowan County, which produced by far the larger amount of copper ore, was also the largest producer of silver. In the table below there is given the production of gold and silver (coining value) in North Carolina during 1903 and 1904, by counties:

PRODUCTION OF GOLD AND SILVER IN 1903 AND 1904
BY COUNTIES.*

COUNTY.	1903			1904		
	GOLD†	SILVER†	TOTAL†	GOLD†	SILVER†	TOTAL†
Alamance	\$-----	\$-----	\$-----	\$ 23.26	\$.27	\$ 23.53
Anson				52.56	1.32	53.88
Burke	1,606.44	17.09	1,623.53	1,507.03	23.03	1,530.06
Cabarrus	3,237.23	85.93	3,323.16	14,889.80	193.08	15,082.88
Caldwell	41.10	.87	41.97	46.52	.41	46.93
Catawba	1,181.07	19.09	1,200.16	5,438.29	105.75	5,544.04
Chatham				96.74	1.60	98.34
Cherokee	1,144.52	5.91	1,150.43	123.76	.74	124.50
Clay	46.51	.29	46.80	57.90	.36	58.26
Cleveland	5,269.40	1.16	5,270.56	180.47	4.46	184.93
Davidson	230.12	161.52	391.64	1,102.77	590.91	1,693.68
Franklin	162.79	2.48	165.27	88.37	1.86	90.23
Gaston	196.84	2.85	199.69	217.88	4.71	222.59
Granville	562.68	2,258.97	2,821.65	610.07	1,189.05	1,799.12
Guilford	3,806.62	159.16	3,965.78	12,853.11	46.16	12,899.27
Halifax	423.81	2.63	426.44	178.54	1.45	179.99
Henderson	186.05	2.33	188.38	32.31	.37	32.68
Iredell	133.84	1.60	135.44	162.20	2.51	164.71
Lincoln	522.42	9.90	532.32	35.03	.84	35.87
Macon	93.02	.58	93.60	46.52	.30	46.82
McDowell	2,260.15	30.60	2,290.75	602.78	14.10	616.88
Mecklenburg	8,578.72	102.89	8,681.61	1,157.99	25.04	1,183.03
Montgomery	48,634.83	878.27	49,513.10	50,460.88	901.46	51,362.34
Moore	388.87	8.04	396.91	310.46	7.04	317.50
Nash	139.54	2.15	141.69	44.18	.95	45.13
Orange	351.46	5.11	356.57	23.26	.15	23.41
Person	1,096.15	8,632.24	9,728.39	171.50	2,734.51	2,906.01
Polk	602.21	4.22	606.43	192.78	1.86	194.64
Randolph	396.30	6.96	403.26	397.62	12.99	410.61
Rowan	1,852.39	4,119.21	5,971.60	4,163.72	12,852.09	17,015.81
Rutherford	1,322.20	16.91	1,339.01	484.95	3.24	488.19
Stanly	24,524.30	116.05	24,640.35	17,113.65	157.32	17,270.97
Union	3,101.84	95.68	3,197.52	9,677.08	224.56	9,901.64
Warren	139.54	1.75	141.29	359.07	2.36	361.43
Unknown	1,370.59	154.22	1,524.81	1,020.95	25.73	1,046.68
Total	113,603.55	16,906.66	130,510.11	123,924.00	19,132.58	143,056.58

*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

As is seen from the above table, all the counties producing gold in 1903 were also producers in 1904, and in addition were the three counties, Alamance, Anson and Chatham.

The next table following shows the value of the production of gold and silver in North Carolina since 1882.

**GOLD AND SILVER PRODUCTION IN NORTH CAROLINA
FROM 1882 TO 1904.***

YEAR.	GOLD.	SILVER.	TOTAL.
1882	\$ 190,000	\$ 25,000	\$ 215,000
1883	167,000	3,000	170,000
1884	157,000	3,500	160,500
1885	152,000	3,000	155,000
1886	175,000	3,000	178,000
1887	225,000	5,000	230,000
1888	136,000	3,500	139,500
1889	145,000	3,878	148,878
1890	118,500	7,757	126,257
1891	95,000	6,465	101,465
1892	78,560	12,671	91,231
1893	53,600	17,325	70,925
1894	46,594	455	47,049
1895	54,200	520	54,720
1896	44,300	646	44,946
1897	34,600	388	34,988
1898	84,000	905	84,905
1899	34,500	388	34,888
1900	44,653	15,986	60,639
1901	60,410	34,023	94,433
1902	93,650	30,212	123,862
1903	113,604	16,907	130,511
1904	123,924	19,133	143,057

*Coining value.

COPPER.

Copper mining in North Carolina has not yet become a very important industry, although there are now a number of properties that are being vigorously developed, but which have not yet become producers of copper. With the closing down of the Holloway mine in Person County, which was the largest producer in the State, there was a large falling off in the production of copper ore. This mine, however, has recently been purchased by Philadelphia parties, who are contemplating re-opening it or developing ore bodies that are supposed to exist along the strike of the Holloway vein. The Yancey mine, belonging to the Person Consolidated Copper and Gold Mines Company, was not worked to any great extent during 1904, and only a few car-loads of concentrates were shipped. Thus the production of copper ore from Person County has been very much reduced. Many of the copper properties were not worked at all during 1904 while others were developed to a slight extent, and at still others work was carried on vigorously and in some instances plants were erected for the mining and treating of the ore.

The Hercules Gold and Copper Company, at Cid, N. C., spent a large part of the year in sinking and drifting on their ores, and have a large body of ore now blocked out and ready for stoping. They have erected a complete concentrating plant, which is now in operation, and during 1905 this property should produce a considerable quantity of ore.

The Union Copper Mining Company's mines at Gold Hill, Rowan County, were the largest producers in 1904, but, compared to their plant and their ore bodies, their production was very small. None of the ore was smelted at the company's plant, but was shipped to the Bucktown smelter of the Tennessee Copper Company.

There are a number of other copper properties that were being developed in various sections of North Carolina during 1904, including those of the North Carolina Mining and Milling Company, in Stanley and Cabarrus Counties, the Carolina Copper Company, in Jackson County, and the Whitney Company, in Rowan County. The Bre Knob Copper mine, of Ashe County, which was equipped with Garretson furnace three years ago and which was blown in and operated for a few days, is again to be opened up in the near future. The method of reduction of these ores is by pyritic smelting.

PRODUCTION.

In 1904 the total production of copper amounted to 4,250 tons of ore, which gave 305,000 pounds of copper, valued at \$36,600, or 12 cents per pound. This was obtained from Person and Rowan counties. As compared with the production of 438,133 pounds, valued at \$67,037, this is a decrease of 133,133 pounds in quantity and of \$30,437 in value. In the following table is given the production of copper in North Carolina in 1900 to 1904:

PRODUCTION OF COPPER FROM 1900 TO 1904.

YEAR.	CRUDE ORE MINED.	COPPER PRODUCED.	VALUE.
	<i>Tons.</i>	<i>Pounds.</i>	
00	6,948		\$ 41,600
01	10,398	512,666	76,900
02	16,741	1,417,020	212,553
03	4,106	458,133	67,037
04	4,250	305,000	36,600

IRON.

Although there are numerous deposits of iron ore in North Carolina which contain good ore in quantity, there are but few of these that are being operated. There are several reasons why the other deposits are not being operated: as their distance from sources of fuel and flux, or their distance from railroad transportation. Thus, the ore deposits near Wilson's Mills, Jackson County, and Ore Hill, Chatham County, were obliged to cease operations with the closing down of the Greensboro iron furnace. The large deposits of iron ore at the Ballew mine, in Ashe County, are a long distance from fuel and also from railroad transportation. This deposit is a magnetic iron ore and occurs in large quantity, and if it should be connected with the coal-fields of West Virginia by railroad facilities, this deposit would undoubtedly be worked very extensively.

During 1904 the only mines that were operated were the celebrated Cranberry mines, at Cranberry, Mitchell County, which contains magnetic iron ore and furnishes a pig-iron of superior quality. This mine is the most famous and noted one in the State and has been the only constant producer of iron ore. The other property that was worked was a deposit of brown hematite iron ore near Andrews, Cherokee County.

PRODUCTION.

The total production of iron ore in North Carolina during 1904 amounted to 64,347 long tons, valued at \$79,846, and was obtained from Mitchell and Cherokee Counties. As compared with the production of 82,851 tons, valued at \$78,540, the 1904 production is a decrease of 18,504 tons in quantity, but an increase of \$1,306 in value.

CHROMITE.

Although there was no chromite ore produced in North Carolina during 1904, yet on account of the constant demand for this mineral in the United States, which is supplied almost entirely by imported ores, and on account of the construction of railroads which now pass very close to extensive chromite deposits, this mineral is treated somewhat briefly in this report.

Chromite is an iron-black to brownish-black mineral in color, having a sub-metallic luster. Its hardness is 5.5. Its chemical composition is usually represented by the formula FeCr_2O_4 , where a part of

ne iron is replaced by magnesia and the chromium by aluminum and ferric iron. It is found in small amounts in a great many places throughout North Carolina as an associated mineral in peridotite formations, where it occurs in grains and crystals and frequently in imbedded masses near the contact of this rock with the gneiss or other country rock. It is usually massive and from fine granular to compact, but occasionally it is found in small, but perfect, octahedral crystals. At a number of localities in the western part of the State it has been found in considerable quantity, and with proper railroad facilities some of these deposits should be capable of being worked profitably and become sources of supply of chromite. One of the more promising localities is in Yancey County at Mine Hill on the Mine Fork of Jack Creek, 5 miles north of Burnsville, the county-seat, on the Bakersville Road, where a large peridotite (dunite) formation outcrops on both sides of the road. Seams or pockets of chromite ore are abundant in this peridotite, varying from 0.5 inch to 3 inches in thickness. Near the summit of the hill, on the east side of the road, about 150 feet above the road and stream-bed, a deposit of chromite has been opened from which 25 tons of ore were taken, a large part of which still remains on the dumps. A pit 9 feet deep was sunk on the deposit; but this has been filled with water since the work ceased, so that no estimate can be made of the extent of the deposit. Mr. Garrett Ray, of Burnsville, N. C., the owner, reports that the chromite extended to between 2 and 3 feet at the bottom of the pit. There are other promising seams or veins, which appear to indicate the existence of a deposit of chromite ore near the contact of the peridotite and gneiss.

On the west side of the road the peridotite formation rises in another hill, and here there are numerous small seams and pockets of chromite. On the extreme western slope of the formation a trench has been cut 100 feet or more into the hill, in which are exposed many small pockets of chromite. The work done in this trench is of a historic character, and whether the object of the exploration was chromite or not has never been explained.

With the exception of the pit sunk near the summit of Mine Hill, from which a few tons of ore were shipped, no mining has been done here, and very little prospecting has been undertaken to determine the exact extent of the chromite deposits. The distance from the railroad has greatly discouraged systematic prospecting in this region. The

shipping point at the time this work was done was Asheville, on the Southern Railway, about 40 miles to the south. The railroad from Erwin, Tenn., to Marion, N. C., which is now partially completed, passes within 3 or 4 miles of this locality.

An analysis of a selected specimen of the chromite (Baskerville, analyst) gave the following results:

ANALYSIS OF SELECTED SPECIMEN OF CHROMITE FROM MINE
HILL FIVE MILES NORTH OF BURNSVILLE, YANCEY COUNTY.

	Per Cent.		Per Cent.
Cr ₂ O ₃	56.00	MgO	8.25
Al ₂ O ₃	15.52	SiO ₂	3.20
FeO	14.45	CaO	.70

Although this analysis represents a selected sample of the chromite, yet from the character of the material it is not unreasonable to expect an ore that, by hand-picking and cobbing, will assay in the neighborhood of 52 per cent. of chromic oxide, with a low percentage of silica.

About 9 miles west of Burnsville, near Price Creek, there is a narrow bed of peridotite on the land of Mr. W. A. Robertson, a quarter of a mile from Price Creek post-office. A pocket of chromite discovered here yielded nearly 7 tons of ore. This exhausted the pocket, and since then no prospecting has been done in this vicinity.

An analysis of a selected sample of this ore (Baskerville, analyst) gave the following results:

ANALYSIS OF SELECTED SAMPLE OF CHROMITE FROM PRICE
CREEK, NINE MILES WEST OF BURNSVILLE, YANCEY COUNTY.

	Per Cent.		Per Cent.
Cr ₂ O ₃	59.20	MgO	4.42
Al ₂ O ₃	7.15	SiO ₂	3.20
FeO	25.02	MnO	.92

In Jackson County, in the vicinity of Webster, there is a large peridotite (dunite) formation extending for about half a mile north of the town to a mile and a quarter south. The widest part of the area, about a half a mile, is at Webster, the town being partly built on a dunite hill. The Tuckaseegee River cuts through this formation about a half a mile below the town. Considerable prospecting

has been carried on in this region, and numerous veins and pockets of chromite of varying extent have been discovered.

The only deposit of any note found on the north or Webster side of the river is on the east side of the Tuckaseegee Road, about 200 yards from the main street of the town, on the land of Daniel Schneider. A pocket of chromite was uncovered here which yielded a number of tons of chromite, most of which was shipped. At a depth of nearly 9 feet the pocket pinched out, leaving but a small seam of chromite in sight. Many small seams and pockets of chromite are to be seen, but no other work has been undertaken for chromite on this side of the river.

On the south side of the river, following closely the contact of the dunite with the gneiss, a line of prospect pits have been dug which show the presence of a considerable amount of chromite. The prospecting has been done on the land of Joseph Hooker, Lawrence Buress, Alf Wilson, James Ashe and Daniel Fullbright, all of Webster, N. C. The most promising deposits are one on the land of James Ashe, where a cut 25 feet long, 6 to 8 feet wide and 8 to 10 feet deep was sunk on a vein of chromite 12 to 18 inches thick, which at the bottom of the cut is 12 inches thick; and another on the land of Daniel Fullbright, where a seam nearly 12 inches thick is exposed in the branch. The nearest shipping point is Sylva, on the Southern Railway, 3 miles north of Webster.

Chromite has been found at a number of places in the masses of peridotite within two or three miles southwest of Balsam Gap, Jackson County. The most promising outlook for a large deposit is on Dark Ridge Creek, about 525 feet south of the Dark Ridge trestle of the Murphy Branch of the Southern Railway. On the east side of the creek a cut 18 feet deep and 10 feet wide was made on a pocket of chromite, from the bottom of which two seams of chromite, 6 and 8 inches thick, respectively, extended. Fifteen tons of ore were taken out of the main pocket. About 200 yards farther south, on the opposite side of the creek, a shallow pit was sunk which encountered considerable chromite. Both these openings were near the contact of the peridotite and gneiss. Between these and in their near vicinity there is a large quantity of float ore. These facts point to this locality as one worthy of further development, with an expectation of finding a large quantity of ore. Its proximity to the railroad is also a great advantage. Analyses show the ore to carry about 49 per cent. of

Cr_2O_3 . The property is owned by the Highland Forest Company, of Waynesville, N. C.

No large deposits of chromite have yet been found in North Carolina, but the work done shows that extensive deposits may exist in the State, those described above being the most promising ones known.

The standard chrome ore contains 50 per cent. of Cr_2O_3 , and the value of the ore increases with each unit over this. Ores as low as 45 per cent. of Cr_2O_3 find a ready market, if they are low in silica. The North Carolina ores are of high grade and are usually low in silica.

The largest use of chromite is in the manufacture of ferro-chromium alloys and the metal chromium, which is used in the manufacture of chrome steel. This in turn is used in the manufacture of armor-plate used in combination with nickel. The manufacture of the ferro-chromium alloys can be accomplished in the electric furnace, crucible furnace, or blast furnace, but at the present time it is made most extensively in the electric furnace. Formerly, however, before the converting of our water-powers into electric power, the principal method of making ferro-chrome was in blast furnaces. By this process, however, only a low-grade ferro-chrome alloy could be obtained, the chromium content being from 30 to 40 per cent. With, however, the introduction of the electric furnace for the manufacture of these alloys, the chromium content has been increased to 60 per cent. and upwards, and at the present time the alloys that seem to be in the greatest demand are those containing from 60 per cent. or more of chromium. The main objection to the use of crucible furnaces is that only small quantities of the ferro-chrome alloy can be prepared at one time, but the chromium content is very high. Ferro-chrome alloys are now being prepared in large quantity by means of the electric furnace in the United States, in France, and in Germany. Where formerly these ferro-alloys were apt to contain a rather high percentage of carbon, the processes have now been so improved and regulated that ferro-chrome alloys can now be made in the electric furnace that contain but a fraction of a per cent. of carbon, and the product of the furnace can now be made approximately uniform.

Some of the principal firms manufacturing ferro-chrome alloys are the Wilson Aluminum Company, at Kanawha Falls, West Virginia, and Holcomb Rock, Virginia; Chrome Steel Works, Brooklyn, New York; the Hecla Works, Sheffield, England; Geo. G. Blackwell Sons & Co., Liverpool, England; and Hugo Krupp, Hanover, Germany. In

ance there are a number of plants manufacturing ferro-chrome, as follows: *Société Electrometallurgique Française at La Praz, Société Néo-Métallurgie at Giffre, Société Anonyme Electrometallurgique Albertville; Keller, Leleux & Co., at Livet; Société Electrometallurgique de Saint-Béron at Saint-Béron, Ch. Betrolus at Bellegarde, d Rochette Frères at Epierre.

TIN.

Although there was no shipment of tin ore in North Carolina during 1904, there was considerable development work carried on by the Carolina Tin Company, at the Jones mine, in Gaston County, about 10 miles north of Kings Mountain. During this work two shafts 200 feet apart were sunk on the vein, one to a depth of 100 feet and the other 41 feet. This work has shown the vein to be continuous to these depths, and from these shafts 300 feet of drifts have been run at different levels. From the 150-foot shaft a 23-foot vein was cut on the west side of the shaft whose trend is northeast and southwest and arching toward the west. A new shaft has been started at a point that it will cut the vein at a depth of 300 feet. This vein, which was followed from the 150-foot shaft, widened from where first encountered to 27½ feet.

Other properties that are being worked are the Beaver Dam property, about 11 miles northeast of Kings Mountain, and the Parker mine, which is within the corporate limits of Kings Mountain. This latter property has been worked to a depth of 25 feet.

A detailed description of the Tin Deposits of the Carolinas has recently been published as Bulletin No. 19 of the North Carolina Geological Survey.

ABRASIVE MATERIALS.

The abrasive materials that were mined in North Carolina during 1904 included millstones, garnet and corundum, given in the order of the importance of their productions. This industry in the State is not large and, since the closing down of the corundum mines at Hlasaja, Macon County, and the garnet mines at Sugar Loaf Mountain, Jackson County, the value of the production of abrasives has been very small.

*Electrochemical Industry. Vol. II, 1904, p. 450.

The most noticeable change of the abrasive industry during the past year has been the production of garnet from a locality near Marshall, Madison County, which was described in the report for 1903. The only corundum property that was operated during 1904 was the Herbert mine, owned by the North Carolina Corundum Company and located at Buck Creek, Clay County. The millstones were all obtained from near Faith, Rowan County.

PRODUCTION.

The total production of garnet and corundum in 1904 amounted to 202 tons, valued at \$6,586, which is a decrease of 201 tons in quantity and of \$7,664 in value as compared with the production of 403 tons, valued at \$12,250, in 1903. There were 208 pairs of millstones, valued at \$6,500, produced in 1904, as compared with 63 pairs, valued at \$902, produced in 1903. This makes the total value of all the abrasive materials produced in 1904 \$13,086, as compared with \$13,152, the value of the 1903 production. The production of these abrasive materials for 1901 to 1904 are given in the following table:

PRODUCTION OF ABRASIVE MATERIALS 1901-1904.

YEAR.	CORUNDUM.		GARNET.		MILLSTONES.		TOTAL VALUE.
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	
	Tons.		Tons.		Pairs.		
1901 -----	325	\$48,840	775	\$43,000	-----	\$-----	\$91,840
1902 -----	----	-----	260	10,040	50	1,425	11,465
1903 -----	----	-----	403	12,250	63	902	13,152
1904 -----	----	-----	202	6,586	208	6,500	13,086

MICA.

INTRODUCTION.

North Carolina still continues to be the chief mica-producing State of the United States, and its mica is the standard mica by which all the others are graded. Although this mineral occurs widely distributed throughout the United States and has been found in commercial sizes in about one-third of the States and Territories, it is only in a few that it is a mining industry. During 1904, mica

was mined in California, Colorado, Connecticut, Georgia, Idaho, North Carolina, New Hampshire, New Mexico and South Dakota, nearly ten-elevenths of the total value of this mica produced in the United States having been obtained from North Carolina. Besides the domestic production of mica, there is a considerable quantity imported each year, which is obtained principally from Canada and India.

COMMERCIAL VARIETIES OF MICA.

There are a number of minerals that belong to the mica group, only a few, however, being of commercial value, namely, muscovite, phlogopite, and lepidolite. The last of these three minerals is only mined for its lithia content, and is not used for any of the purposes of a commercial mica. The other two micas—muscovite and phlogopite—include all the commercial mica that is on the market. In North Carolina it is only the muscovite that is mined, as there are at the present time no known commercial deposits of phlogopite in this country. In Canada and India, on the other hand, the chief mica deposits are of the phlogopite variety, with smaller deposits of muscovite.

Muscovite mica is chemically a hydrous potassium aluminum silicate, and is classified as potash mica. It is usually transparent and colorless, constituting most of the white mica on the market. Occasionally it is of a rum to ruby color. Frequently there are other minerals inclosed by the mica, sometimes crystallizing in finely-divided films between the foliæ of the mica, as magnetite, flattened garnet, quartz, and tourmaline crystals, and these sometimes ruin the blocks of mica completely as a source of sheet mica.

Phlogopite mica, which is also known as magnesia mica, is a hydrous magnesium aluminum silicate, containing also some potash and soda. It is usually of a rather even color, which varies from a yellowish brown to brownish red with often something of a copper-light reflection. Occasionally it assumes a nearly black color. A considerable part of the amber mica on the market is the phlogopite variety, and Canada furnishes the chief supply.

Another mica that is commonly associated with muscovite in many pegmatitic dikes is biotite, an iron magnesia mica similar in composition to the phlogopite, but having a large part of the magnesia

replaced by iron. It is much darker in color than the phlogopite, being nearly black, and does not occur in as large crystals.

The commercial value of muscovite and phlogopite is due to the very high development of the basal cleavage which permits of the splitting up of the crystals and blocks of mica into sheets of one-thirty-second or one-sixteenth of an inch in thickness as used commercially, but the cleavage can be continued perfectly up to at least one one-thousandth of an inch.

OCCURRENCE.

The muscovite represents the most common mica and is very widely distributed, being a component of many of the crystalline and sedimentary rocks. In many of these it occurs in but small scales or crystals which have no commercial value. When, however, it occurs in blocks or masses which can be split into sheets an inch or more in diameter, it has a commercial value which increases with the size of the cut sheets, and these vary from 1 by 1 to 8 by 10 inches. These commercial deposits of mica are found for the most part in pegmatitic dikes or veins, which occur as intrusives in granite and in hornblende and mica gneisses and schists. These dikes or veins vary in thickness from a few inches to several hundred feet and are often very irregular, having arms or apophyses branching off from them and extending out into the country rock in many directions. Sometimes these dikes are parallel to the bedding or schistosity of the gneiss or schist, and then again they break across it at varying angles. Both of these phenomena are often observed in the same dike. In character these pegmatitic dikes are very similar to granite, and occasionally they have been designated as a "coarse granite." The principal mineral constituents of these dikes are quartz, feldspar, and muscovite mica, which occur in varying proportions. In examining these dikes it will be found that sometimes the quartz and feldspar are nearly equally distributed throughout a certain part of the vein, while in other parts sometimes one and again the other will predominate. Feldspar has been observed that has crystallized out in enormous masses of more than a ton in weight, and in one instance, the Irby mine, near Spruce Pine, Mitchell County, N. C., a well-developed crystal of feldspar was observed that measured 3 by 11½ feet. Occasionally feldspar, quartz, and mica have separated out in rather small

masses, giving the vein the appearance of containing an equal quantity of each. In such cases the three minerals are so intimately associated with each other that the mica is of little or no commercial value and the feldspar is also of no commercial value. Judging from observations made at a great many mica mines, the pegmatitic dikes that yield the best commercial mica are those in which the three minerals have had a tendency to crystallize out in large masses. Thus, where feldspar and quartz are in small crystals or fragments, the mica is also apt to be small. Those dikes that are two feet or less in width very seldom contain mica having any commercial value beyond what could be obtained for it as scrap mica, and hence little or no attention should be paid to such dikes as a source of mica. Not all of the wide dikes carry mica of the right quality or in sufficient quantity to afford profitable mining, for in some the mica has been observed to occur in such small crystals and blocks that no sheets could be obtained over an inch or two in diameter.

The muscovite mica occurs in these dikes usually in rough crystals (called blocks or books, which are sometimes distributed nearly evenly throughout the dike and at other times nearer the contact of the dike with the country rock. These blocks of mica are occasionally nearly perfect in their crystalline form, which is monoclinic, but imitating rhombic or hexagonal symmetry. The commercial blocks of mica usually vary in thickness from 6 to 18 inches and from 3 to 15 inches in diameter, although some blocks have been found as much as 4 feet in diameter and from $2\frac{1}{2}$ to 3 feet in thickness. All of the large blocks of mica are not of sufficient quality to cut into sheets as large as would be expected from the size of the crystal, on account of much of the mica having been converted into what is called "ruled mica," the mica being divided into narrow strips whose edges are parallel to the intersection of the prism and base edges of the crystal, or into "A" mica, in which the sheets are cut or striated parallel to two adjacent edges.

PERCENTAGE OF MICA IN THE DIKES.

There is considerable variation to be noted in the percentage of mica that occurs in these dikes and in different parts of the same dike. It is usually found, however, that in any considerable distance in the same dike the mica will average for that distance approximately the same per cent. It is seldom that the mica in a dike will average over

10 per cent. of the contents of the dike for any considerable distance, and it will sometimes average as low as 1 per cent. Portions of certain dikes have been observed that had the appearance of containing a very large percentage of mica on account of a number of blocks of mica being clustered together in bunches almost touching one another, while in other portions of the same dike there would be almost a complete absence of mica for a distance of from 5 to 20 feet; but even in such a dike the general average of the mica to the other minerals corresponded to about 10 per cent. The general limits of the percentage of mica in various dikes is probably, therefore, from 1 to 10 per cent.

Of the mica that is obtained in these dikes, there is probably an average of not over 10 to 15 per cent. that can be cut into sheet mica, the rest being waste or scrap mica. Selected masses or blocks of mica, however, have been mined that have averaged from 30 to 40 per cent. and occasionally as high as 75 per cent. of sheet or plate mica. On the other hand, there will be certain portions of the dike in which none of the mica mined can be cut into sheets or plates, and is all of value only as scrap mica. These variations have been observed where they have taken place within the space of a few feet. As far as can be ascertained from observations in the field and from the results of mining, the North Carolina mines will average the highest percentage of cut mica of any in the United States.

There are a number of reasons for this large percentage of waste mica—the irregularity of the blocks of mica and of the individual sheets; the ruled mica and the “A” mica, which reduce the sizes of sheets that can be cut or prevent entirely any sheets being cut from the block; the mica may be specked or stained, or may contain a great deal of magnetite in thin crystallized films between the foliæ of the mica; and many blocks of mica may be destroyed by having garnet, tourmaline, or quartz crystallized out between the foliæ. It will be observed from what has been said that in mining mica there must necessarily be a very large amount of waste rock or gangue removed, and, as in nearly all mica mining it is necessary to operate by blasting, it makes the cost of production of the crude mica somewhat expensive. Hence, if any of the other minerals that must be removed in mining can be utilized commercially, they will make valuable by-products and will help to pay the cost of mining the mica. There are certain minerals associated with the muscovite mica in these veins.

that are of commercial value and that are discussed later under Associated Minerals.

METHODS OF MINING.

The mining of mica in North Carolina has been carried on largely in a desultory manner and by individuals who had little or no capital which would enable them to mine systematically or continuously on a vein when the mica in the vein became poor. A great deal of the mining has been done by open cuts and pits and shallow shafts which, as soon as they reach water-level, were abandoned; by low tunnels which have followed in on the veins where good mica had been exposed on the surface or was very quickly encountered as the tunnel was extended. These tunnels were always small and often zigzag and without any definite direction or size, and have led to the term "ground-hogging" as applied to considerable of the mining in North Carolina. Other mica deposits have been opened up by inclined shafts, with drifts running from them on the vein at various levels and the vein material in between the levels partially stoped out. In other cases sections of the vein have been mined from the surface downward, the walls being supported by large timbers. There are but very few of the mines that have been equipped with steam plants for hoisting the mica and waste, and nearly all this has been done by hand or horse windlass. By mining the mica deposits by means of a compartment working shaft, from which drifts are extended at regular intervals and stoping out the vein material between these levels, it would only be necessary to raise to the surface the mica, leaving all the waste material to fill up the stopes. In many instances the dip of the veins is not far from the vertical, so that the shaft will be in the vein for a good many feet. Usually the walls are firm, so that there is but little timbering necessary in the drifts and stopes.

On account of the irregularity of the occurrence of the blocks or books of mica in the vein, nothing is known of their position by the miner unless he has exposed one or more by previous blasting, and it often happens that in drilling the drill will pass right through one of these blocks of mica, often ruining some very large sheets. Though this may sometimes become apparent by the material that is taken out of the drill hole, still the miner would be unable to determine whether his drill was in contact with a good block of mica or merely with small masses, and so the only thing for him to do is to keep on

with the hole he is drilling and to let the blasting reveal what kind of a block of mica he has drilled into. The percentage, however, of blocks of mica that are spoiled by drilling is very small. Occasionally, after blasting, the miner will find exposed in the face of his drift a half dozen or more blocks of mica, some with the face of the block exposed and others with just their edges showing. He is then able either to gad out these blocks or, by means of pop holes, to remove all of the blocks without injuring them. It is customary in many of the mica mines to blast out the mica and gangue by means of benches, which perhaps eliminates, as far as possible, the chances of ruining the good blocks of mica.

ASSOCIATED MINERALS.

As has already been stated, the three principal minerals of these pegmatitic dikes are quartz, feldspar and muscovite mica, and these probably constitute about 95 to 99 per cent. of the dike. Besides these, there are a large number that occur in these pegmatitic dikes, sometimes sparingly and at other times abundantly. A list of these minerals was given in the report for 1901. *The majority of these minerals are found very rarely in pegmatitic dikes and some have been found at only one locality. Others are found frequently throughout many of the pegmatitic dikes, although some dikes have been observed that contained no other minerals besides feldspar, quartz and mica. Of these associated minerals, the common accessory minerals are beryl, some one of the garnets, tourmaline and apatite. Magnetite is a mineral very commonly associated with the mica in these pegmatitic dikes, and occurs as small films of mineral crystallizing out between the foliæ of the mica. In certain localities, as at the Wiseman and Flat Rock mines, Mitchell County, the uranium minerals, uraninite, gummite, etc., are quite common; also the tantalum minerals, columbite, and samarskite are found in a number of the pegmatitic dikes of Mitchell and Yancey Counties. These latter are described beyond on pages 46-53. A number of these accessory minerals are the gem minerals, some of which have been found in commercial quantity, as the different beryl gems, garnet, hiddenite, rutile, etc.

*Economic Paper No. 6, 1901, p. 42.

Where any of these associated minerals can be utilized commercially, they make valuable by-products. The most promising ones in North Carolina are quartz and feldspar, which could be used for pottery purposes; beryls for gems; columbite as a source of tantalum; and uraninite or pitchblende and gummite for their radium contents.

LOCALITIES.

The principal deposits of mica in North Carolina are in Ashe, Mitchell, Yancey, Jackson, Haywood, Macon, Transylvania, Cleveland, Lincoln, Caldwell, Watauga and Stokes counties. The principal mines that have been worked are the Clarissa, Sink Hole, Hawk, Doublehead, Spread Eagle, Deake, Gibbs, Aley, Young and Cloud-and mines, in Mitchell County; the Ray, Presnell, Little Zeph, Roberson, Sleepy Hollow, Tolly Bend and Young mines, in Yancey county; the Big Ridge and Sherry, in Haywood County; the Iola, Turningtown and Rabe, in Macon County; the Empire and Hawkins mines, in Stokes County; the Grimshawe mine, in Transylvania county; the Beaver Creek mine, in Caldwell County; Stony Fork mine, Watauga County; the Laytown, Royster and Stemley mines, Cleveland County; and the Gault and Houser mines, Lincoln County.

More or less development work and mining was carried on at nearly 1 of these properties during 1904, although at many of them there was no production of mica, this being true of the mines east of the Blue Ridge.

With few exceptions, the mica deposits at the above localities are worked by individuals and generally on a very small scale, so that there are a large number of small producers of mica in North Carolina who have worked their deposits for a few days to a few months during the year and obtained mica valued at from \$10 to \$500 as a yearly production. There are, however, a few large companies who are carrying on systematic mining, sinking their shafts below water-level and having their mines equipped with steam hoisting and pumping plants. Some of these shafts are down between 400 and 500 feet. The principal companies operating are the Burleson Mica Company, in Mitchell and Yancey counties; the Sylva Mining Company, mining principally in Haywood and Jackson and Macon counties; and the Laytown Mica Company, in Caldwell County. Although the Ashe County localities were not in operation during 1904, there are

a number of favorable localities for mica mining which give promise of containing a good quality of mica in commercial quantity.

The mines of Watauga County, in the vicinity of Stony Fork, were worked for about two months during 1904, principally by Arthur Welsh, of Stony Fork, without, however, any production of mica.

USES.

Twenty-five years ago, almost the only use for mica was for cutting into sheets of varying sizes to be used for stoves, and the very small pieces of scraps obtained from cutting the plates or sheets, together with the waste obtained in mining, were thrown away as valueless. Now, however, there is a very large demand for mica for electrical purposes, and this has resulted in the utilization of a great quantity of the small pieces of mica that were first thrown away and were then used as scrap mica, which was ground. These pieces are now cut by machinery into small circular disks (1 inch in diameter) and rectangular pieces ($\frac{3}{4}$ by 2 inches), which are used for insulation purposes in electrical apparatus. Larger sheets of mica are also used for electrical purposes, but it has been found that a large sheet can be built up from small ones, which will give as satisfactory results as the single large sheet, and are, of course, not so expensive. The use of the sheets of clear, white mica for stoves has decreased very rapidly during the last ten years, and there is not now the demand for as many of the larger sheets as there was formerly, although the decrease in the demand for use in stoves has been somewhat balanced by the demand for the sheets for the manufacture of chimneys for incandescent lights and for use in the manufacture of many novelties.

The large percentage of scrap mica, which constitutes from 75 to 90 per cent. of the mica mined, and which was formerly all thrown away, is now utilized principally in the form of ground mica. This ground mica, which is separated into different sizes and grades, is now being utilized for a great variety of purposes. The coarser grades are used in the manufacture of fire-proof materials, principally paint, and for the packing of steam-pipes, boilers, etc., to prevent radiation of heat, as mica is a very good non-conductor. In the manufacture of lubricating materials, the mica must be ground to a still finer degree; and the very finest product is used in the manufacture of certain kinds of wall papers, for other decorative purposes, and in the manufacture of paints.

PRODUCTION.

The production of plate or sheet mica during 1904 was 610,121 pounds, valued at \$100,724, this being an increase of 225,121 pounds in quantity and of \$14,424 in value, as compared with the production of 385,000 pounds, valued at \$86,300, in 1903. This large increase in the quantity of mica produced as compared with the decrease in value is due principally to the larger production of the small disks and rectangular sheets that were used so largely for electrical purposes. The scrap mica produced in 1904 amounted to 341 tons, valued at \$3,410, an average of \$10 per ton. As compared with the production of 1903 of 300 tons, valued at \$2,400, this is an increase of 41 tons in quantity and of \$1,010 in value. There is given the following table the approximate value of the production of sheet mica by counties for the years 1900 to 1904, inclusive:

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900, 1901, 1902, 1903 and 1904, BY COUNTIES.

COUNTY.	1900.	1901.	1902.	1903.	1904.
Ashe	\$-----	\$-----	\$-----	\$ 1,000	\$-----
Lincolnton	-----	-----	250	300	-----
Lincolnton	-----	-----	-----	-----	10,000
Lincolnton	11,000	11,500	20,000	18,000	34,500
Lincolnton	7,000	8,740	5,700	5,500	924
Lincolnton	1,000	500	600	1,000	-----
Lincolnton	5,200	-----	4,000	3,500	-----
Lincolnton	26,722	33,506	28,203	29,000	21,500
Lincolnton	1,000	-----	1,000	7,500	-----
Lincolnton	500	600	750	500	-----
Lincolnton	12,788	25,003	21,150	20,000	34,000
Total value	\$65,200	\$79,849	\$81,653	\$86,300	\$100,724

QUARTZ.

The only direct mining for quartz in North Carolina is for use as a flux in copper smelting, and the entire mining for this mineral has been confined to Cherokee County, the mineral produced having been shipped to the Ducktown copper furnaces at Ducktown, Tenn. The Pollock mine, in Person County, which produced a certain amount of quartz for fluxing purposes in 1903, which was shipped to the smelters at Norfolk, Va., made no shipments of quartz during 1904. This mine and adjoining property has recently been sold to Philadel-

phia parties, who are developing same and expect to again make this a copper-producing mine.

PRODUCTION.

The total production of quartz during 1904 was 32,972 tons, valued at \$36,269, as compared with 29,462 tons, valued at \$36,827, the production of 1903. This is an increase of 3,510 tons in quantity, but a decrease of \$558 in value. In the table following is given the production of quartz in North Carolina for the years 1901 to 1904, inclusive:

PRODUCTION OF QUARTZ IN NORTH CAROLINA, 1901-1904.

YEAR.	QUANTITY.	VALUE.
	<i>Tons.</i>	
1901	3,000	\$ 7,500
1902	4,500	11,250
1903	29,462	36,827
1904	32,972	36,269

BARYTES.

INTRODUCTION.

The mineral barite, or, as it is commercially known, barytes, is beginning to be used more and more each year as a white pigment, although there may be very little, if any, that is used alone for this purpose. It is, however, used in large quantities to mix with white lead, zinc white, or a combination of both these white pigments. Whereas, formerly, its addition to these other pigments was considered as an adulterant, it is now appreciated that the addition of barytes makes a white pigment more permanent, less likely to be attacked by acids, and freer from discoloration than when white lead is used alone. It is also believed that the barytes gives greater body to the paint and makes it more resistant to the influences of the weather. As is well known, pure white lead, when it remains in the shade or in a dark place, becomes discolored, becoming yellowish, while mixtures of white lead and zinc white, or of white lead and barytes, or of white lead, zinc white and barytes, retain their color permanently, even in dark places. At the present time about four-fifths of the total production of barytes is used in the manufacture of white pigments, the bal-

ance being used in the manufacture of paper and rubber, in the preparation of a material for coating canvas sacks in which hams are wrapped, and in the manufacture of barium compounds, principally the hydroxide.

The barytes that is prepared for market varies considerably in its composition, the principal impurities being silica and lime, as well as traces of iron oxide and of manganese dioxide. These impurities are highly undesirable where the barytes is to be used as a pigment. Although these variations in the quality of the barytes are known and appreciated by those who grind the mineral and prepare it for market, the purchasers of this material for pigments or other purposes are not familiar with these variations and have usually paid little or no attention to testing the product. The barytes should be tested chemically in order to determine its percentage of silica, which would represent the grit contained; also its percentage of lime, iron and manganese. In a first-grade barytes there should be no calcium carbonate, silica, free iron oxide, or free manganese dioxide. It would be well to note not only the color of the dry powder, as compared with some standard sample, but also the color after it has been rubbed down in refined linseed oil. Occasionally, samples of barytes will be found that on grinding with oil assume a grayish or even a reddish shade. Another point to be considered is the quantity of oil required to grind the barytes to a paste. In general, the inferior grades of barytes require more oil for this purpose.

CLEANING AND PREPARING BARYTES FOR MARKET.

During the mining and in the first stages of cleaning the barytes many of the minerals which occur with barytes can be eliminated. The commonly associated minerals of barytes in the large deposits are galena, quartz, calcite (calcium carbonate), limonite (hydrated ferric oxide), either massive or as thin stains on the barytes, and manganese dioxide. In sorting the lump ore as it is mined, that showing streaks of quartz should be eliminated from the first-grade ore. The iron-stained barytes can sometimes be so cobbled that only a small amount of the stained lumps go into the first-grade material. It is the occurrence of these iron stains that necessitates the bleaching of the greater portion of the barytes that is mined. Much of that mined in Germany is ground and prepared for market without any bleaching, and this is also true of some of the barytes produced in this

country. The bleaching process, while not an elaborate one, adds considerably to the cost of production of the first grade of barytes. Where the ore contains considerable galena, in rather large masses, the bulk of it can usually be removed during the process of hand-cobbing the ore; if it occurs as small particles scattered through the barytes, it can usually be almost entirely removed by jigging after the ore has been crushed to one-fourth or one-half mesh. The iron minerals that occur in the barytes may sometimes also be entirely removed in this same manner.

When the barytes has been cleaned as far as practicable by hand-cobbing at the mines and divided into 1, 2, 3, or 4 grades, it is shipped to the mills, where it is further cleaned by crushing and washing or jigging to remove as many impurities as possible. The next process in preparing the barytes for market is known as bleaching*. The ore is crushed to a size varying from that of a pea to half an inch, according to the extent of iron oxide that it may contain and whether this oxide is in the form of scales or as a stain. If as the former, it can often be removed, as stated above, by jigging.

In bleaching the barytes, the crushed mineral is placed in wooden tanks lined with sheet lead and holding from 5 to 25 tons of mineral. The tanks used are either circular or rectangular, the former being preferable for the reason that the steaming can be more uniformly done. The best size is $4\frac{1}{2}$ feet high and 8 feet in diameter. With a tank of this size, one steam inlet is required. The most satisfactory tanks are made of stout, well-seasoned cypress wood, which are well braced on the outside and lined on the inside with heavy sheet lead. A lead coil of pipe $\frac{1}{2}$ to 2 inches in diameter is constructed in such a manner that either steam or water can be supplied through the perforations which are best located at an angle of about 45° to the vertical diameter of the pipe rather than directly on top of the pipe. With the perforations in this position, there is less chance of the holes becoming clogged up by fines dropping into them. In charging the tanks the barytes is added to a depth of about 3 feet and then the dilute sulphuric acid solution, which is used as the solvent, is run in. Steam is admitted by means of the coiled lead pipe, which is closed at one end and provided with small perforations from 6 to 8 inches apart. The steam escaping from these perforations agitates and heats

*Mr Edwin Higgins, Jr., *Engineering News*, Feb. 23, 1905, and *Engineering and Mining Journal*, Vol. LXXIX, 1905, p. 465.

the mixture, which requires from 6 to 80 hours to bleach, depending entirely on the amount of iron contained in the barytes. After drawing off the acid, the cleaned mineral is discharged either by sluicing through a specially constructed spout or else by shoveling over the side of the tank, and is transferred to a washer in which the last traces of the acid and clay material are removed. The cleaned mineral is then dried, either on large pans or by means of some one of the patented rotary driers.

In this bleaching process the manganese dioxide is not removed and the barytes that contains this impurity has to be ground to paste on a 40-mesh screen and then mixed with nitrate of soda, salt, and sulphuric acid in the proper proportions. This mixture is then heated in a specially constructed furnace, by which process the iron and manganese are converted into chlorides, which, being very soluble in water, can be completely removed by washing, the barytes being allowed to settle in a series of tanks, generally three in number.

The next step in the preparation of the barytes for market is reducing it, first to the size of fine sand by means of rolls, and then to an impalpable powder by means of buhr-stones, after which it is ready to be packed for shipment.

PRODUCTION.

In 1904 the production of crude barytes in North Carolina amounted to 13,413 short tons, valued at \$33,930. This quantity and value represents the crude barytes after it has been mined and hand-cobbed ready for shipment to the mill, but does not include the further cleaning as described under the bleaching process. This production is an increase of 6,578 tons in quantity and \$12,583 in value as compared with the production of 1903, which was 6,835 short tons, valued at \$21,347. The average value per ton of the 1904 production was \$2.53, which is 59 cents less than the average value, \$3.12 per ton, of the production of 1903. This production was obtained from Madison and Gaston counties, with by far the larger amount from the former County. In the following table there is given the production of barytes in North Carolina for the years 1901 to 1904, inclusive:

PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA, 1901-1904

YEAR.	QUANTITY, SHORT TON.	VALUE.
1901	6,890	\$ 20,865
1902	14,679	44,130
1903	6,835	21,347
1904	13,413	33,930

MONAZITE AND ZIRCON.

MONAZITE.

Monazite is essentially an anhydrous phosphate of the rare earths cerium, lanthanum and didymium, but usually contains a small varying percentage of thorium. It varies considerably in color, being light-yellow to honey-yellow, reddish, brownish and yellowish-green and it has a resinous to vitreous luster. It is brittle, breaking with conchoidal to uneven fracture, and is from 5 to 5.5 in hardness. This mineral is heavy, having a specific gravity of 4.64 to 5.3. By means of its color and specific gravity it can usually be readily identified.

It is the presence of thorium in the monazite that gives it its commercial value. There is, however, a considerable variation in the percentage of thorium found in the pure monazite, and consequently in the commercial product, which is in the form of sand and contains from 3 to 9 per cent. of this oxide. The thorium is used in the manufacture of the mantles for the Welsbach and other incandescent gas lights. The Welsbach light consists of a cylindrical hood or mantle composed of a fibrous network of the rare earths, the top of which is drawn together and held by a loop of platinum wire. When in use this mantle is suspended over the flame of a burner constructed on the principle of the Bunsen burner, in which the heating, instead of the illuminating, power of the hydrocarbons of the gas is used by burning it with an excess of air. In this manner the mantle becomes incandescent and glows with a brilliant and uniform light. In the manufacture of these mantles a cylindrical network about 1½ inches in diameter is woven out of the best and strongest cotton thread, which is first washed in ammonia and then in warm water, being wrung out in a mechanical clothes-wringer each time. The next operation is the soaking of this cotton network in a solution of the rare earths after which it is dried in a revolving hot-air bath. This network

then cut to a length required for the hood; the cylindrical pieces are shaped over a wooden form, the upper end being drawn together by means of platinum wire. The cotton fiber is eliminated by heating the mantles over a hot Bunsen burner flame, thus leaving the hood composed of the thoria and other chemical compounds. During the burning of the cotton thread there is some shrinkage in the size of the hood. The exact composition of the hoods is not generally known, as it is a trade secret, but they are composed largely of thoria, with smaller quantities of the lanthanum and didymium oxides.

A portion of the cerium obtained in the reduction of the monazite is prepared for market in the form of the oxalate, and is used in the drug trade.

There have been a great many chemical compounds made of the rare earths from monazite in the chemical laboratory of the Welsbach Lighting Company, of Gloucester City, N. J., and considerable experimental work has been done to determine whether these compounds were of any chemical use. A series of experiments* were made to determine as to the chemical value of some of these rare earth compounds as mordants. The results of these experiments were that there were no commercial uses that could be made of these compounds as mordants.

Some interesting scientific results have been recently obtained regarding the relation of uranium and radium, some of which were obtained from experimental work upon monazite.† In this experimental work it has been shown that the proportionality between the uranium and the radium contents of minerals is constant. In carrying out these investigations a series of 22 separate samples, comprising 12 distinct mineral species, were used, among which were four samples of monazite, one from North Carolina in the form of sand and containing 5 per cent. of thoria and 0.43 per cent. of uranium; one from Connecticut, representing a massive specimen which contained about 8 per cent. of thoria and 0.30 per cent. of uranium; a third from Norway, representing a single good-sized crystal, and containing from 7 to 9 per cent. of thoria and 0.41 per cent. of uranium; and the fourth from Brazil, which was in the form of sand, and contained about 5 per cent. of thoria and 0.31 per cent. of uranium. The

**Jour. of Soc. of Chem. Ind.*, Feb., 1904, p. 104.

†*Origin of Radium*, by B. B. Boltwood, *Philosophical Magazine of London*, 1905, p. 599

results obtained in the examination of the monazite minerals are given, together with the results of the other minerals, under the head of Uranium Minerals, on page 49.

One of the interesting facts brought out by Mr. Boltwood's investigations in their reference to monazite is that the thorium has apparently no participation in the production of radium and that the radio-activity of monazite is due to its uranium contents.

ZIRCON.

Zircon is a silicate of zirconium (ZrSiO_4) and is commonly found in clear, tetragonal prisms terminated by the pyramid. It is usually of a grayish, light-brown to reddish-brown color, although it is occasionally found colorless to red and perfectly transparent, when it becomes of value as gem material. It is 7.5 in hardness and has a specific gravity of 4.65. The economic use made of this mineral, besides that which is used for gems, is in the preparation of zirconia, this oxide being used, together with yttria and other oxides, in the manufacture of the glower for the Nernst electric lamp. Besides the oxides of yttrium and zirconium, which are the principal ones contained in the Nernst glower, there are also very small amounts of erbium, cerium, uranium, thorium, and perhaps others of the rare earths.

Nernst Lamp.—The fundamental principle of this Nernst lamp is that certain of the rare earths or refractory oxides will conduct an electric current and glow after they have been heated to redness. This discovery, which was made by Dr. Nernst in 1897, has resulted in the development and perfecting of the glower which is now embodied in the Nernst lamp. This glower is composed of a mixture of the rare earth oxides and is made in the form of a small rod or pencil of chalk-like material, having wire terminals at either end. When cold the glower is an insulator, but by means of the wire the glower becomes heated to redness when a current is passed through these wires, and its resistance gradually decreases until it has reached a red heat, when with 220 volts across the terminals it starts to conduct the current and give light.

In bringing a glower up to its starting point corresponding to a temperature of $1,200^{\circ}\text{ F.}$, use is made of a small electrical heater composed of two or more small tubes, of porcelain, about $1\frac{1}{2}$ inches long and $\frac{1}{4}$ inch in diameter, which are overwound with fine platinum

wire, this being in turn held in place and protected from the intense heat later generated by the glower by an outer coating of porcelain paste. After the glower becomes heated, there is, of course, no further use for the heater, and it is cut out by a small electro-magnet cut-out, which consists of a magnetic coil connected in series with the glower, an armature, and the necessary contacts in the heater circuit. Thus, when the glower has become heated sufficiently, the current begins to pass through it, and when this becomes sufficiently strong the armature is attracted and the contacts are separated, thus disconnecting the heater from the line. The surface of the glower before being used presents a smooth, white, porcelain or chalky appearance, but after having been in use about 500 hours it is rough or crystalline in appearance.

The yttria contents used in the manufacture of the Nernst glower are obtained principally from the mineral gadolinite, which has not thus far been found in North Carolina. There are, however, a number of minerals containing yttria, such as samarskite, euxenite and fergusonite, which have been found in the State. It may be of interest to give here a list of the principal minerals containing the yttrium oxides, although but few of them have thus far been found in sufficient quantity to be a commercial source of yttria.

LIST OF PRINCIPAL YTTRIUM MINERALS.

Yttrocrite.—A fluoride of calcium, with the metals of the cerium and yttrium groups, which has been found sparingly at Amity, Orange County, N. Y., and at Mount Mica, near Paris, Me. This mineral contains about 14.8 per cent. of yttria oxide and 9.3 per cent. of cerium oxide.

Tengerite.—A hydrous yttrium carbonate, with something of a chalk-like appearance, which occurs as thin coating on gadolinite at Ytterby, Sweden, and in Llano County, Texas.

Cappelenite.—This mineral is a borosilicate of yttrium and barium, with smaller quantities of cerium, lanthanum, and thorium oxides. It crystallizes in the hexagonal system in thick prisms, and has a conchoidal fracture. Its color is a greenish-brown, and it has a vitreous to greasy luster. This mineral has not thus far been identified in the United States, but has been found sparingly in Lille Aro, on the Langesund Flord, in southern Norway.

Gadolinite.—This is a basic orthosilicate composed principally of beryllium oxide (glucina), iron protoxide, and the yttrium oxides. The yttria earths, or, as they are sometimes called, the "gadolinite earths," are partially replaced by the oxides of cerium, lanthanum, and didymium. Many of the gadolinite specimens also show a very small quantity of thorina, this being less than 1 per cent. The mineral crystallizes in the monoclinic system, commonly prismatic and terminated by the base. The crystals are usually rough and coarse,

showing no cleavage, but having a conchoidal to splintery fracture. It is a brittle mineral, and has a hardness of 6.5 to 7. It varies considerably in specific gravity, according to the percentage of yttrium oxides, from 4 to 4.5. In color, gadolinite is greenish-black, and sometimes brown; in thin splinters it is nearly transparent, and usually of a grass-green to olive-green color. Its luster is vitreous to greasy. The principal occurrence of gadolinite is in pegmatitic dikes or veins; and it is very often associated with allanite and other minerals containing some of the rare earth oxides.

Yttrialite.—This is an amorphous mineral whose chemical composition is chiefly a silicate of thorium and yttrium oxides, with smaller quantities of cerium, lanthanum and didymium oxides. The percentage of yttrium oxides is 46.50, and of the thorium oxide 12 per cent. It has a vitreous to greasy luster, and in color, on a fresh fracture, it is olive green, approaching drab. On the exterior surfaces it is usually altered to orange yellow. It occurs associated with gadolinite at the Llano County (Texas) locality, and is often found implanted upon it. When first found, this mineral was called green gadolinite, but its true character was determined by Messrs. W. E. Hidden and J. B. Mackintosh, who gave it the name yttrialite. It has been found at this locality in masses of considerable size, one piece weighing approximately 10 pounds.

Allanite.—This mineral occurs quite commonly in the pegmatitic dikes throughout the United States, and in some localities it has been found in some considerable quantity. It is a silicate of calcium, aluminum, and iron, with the rare earth oxides, cerium, lanthanum, and didymium, and smaller quantities of the yttrium oxides. The cerium oxides run up as high as 27 per cent., while the yttria oxides are usually less than 3 per cent. No commercial value at the present time is attached to this mineral. Allanite is a pitch-brown to black mineral with a submetallic to pitchy or resinous luster, and occurs sometimes in well-developed monoclinic crystals and also massive and in embedded, angular, or rounded grains. In the pegmatitic dikes of Massachusetts, Connecticut, Virginia, North Carolina, and Colorado, allanite is a rather commonly associated mineral.

Cenosite.—This mineral is a hydrous calcium-yttrium silicate and carbonate, containing about 37.6 per cent. of yttrium oxides. It is a mineral of a yellowish-brown color and greasy luster, which is thus far known only in the single specimen that was found on the island of Hitterö, Norway.

Roulandite.—This is an yttrium silicate that occurs in massive form associated with the gadolinite of Llano County, Texas. It occurs but sparingly and is of a pale drab-green color when pure, but alters to a waxy, brick-red mineral. An analysis gave 61.9 per cent. of the yttrium oxides.

Fergusonite.—This mineral is essentially a metaniobate and tantalate of yttrium with cerium, uranium, etc. The percentage of yttrium oxides varies from about 18 to 26 per cent. It is a mineral with a rather characteristic brownish-black to liver-brown color and a rather dull luster. Its specific gravity is high, being 5.8. It usually occurs massive, but occasionally well-developed tetragonal crystals have been observed. It has been found at a number of localities, either in granite or in pegmatitic dikes, as in granite at Rockport, Mass., and Amelia, Va., and in many of the mica mines of Mitchell County, N. C., and associated with gadolinite in Llano County, Texas. At this latter locality it has been found in masses weighing over a pound.

Ytrotantalite.—This mineral is essentially a tantalate and niobate of iron, aluminum, and the rare earth oxides, yttrium, erbium, cerium, and uranium. The yttria contents of this mineral vary from about 10 to 19 per cent. It is of a black to brownish-yellow color, with a submetallic to vitreous luster, and has a specific gravity of about 5.8. It has been found in but small quantity at Ytterby, Sweden.

Samaraskite.—This mineral is one of the more abundant minerals containing the rare earth oxides, very large quantities of it being found at the Wiseman mine, in Mitchell County, N. C. It is essentially a niobate and tantalate of iron and calcium with the cerium and yttrium metals, together with the uranium oxide. The yttrium oxides vary from 6 to 15 per cent. and the cerium oxides from about 2 to 6 per cent. The color of samarskite is velvet black, and its luster varies from vitreous to resinous and splendid. It is commonly found massive or in flattened embedded grains, but occasionally in fairly well-developed, prismatic, rhombohedral crystals. Its usual occurrence is in pegmatitic dikes, and the most noted locality is the Wiseman mica mine, in Mitchell County, where it has been found in masses over 20 pounds in weight. At other mica mines in North Carolina it has been found more sparingly.

Euxenite.—This is a niobate and titanate of yttrium, erbium, cerium, and uranium, which occurs commonly massive and is of a brownish-black color. It has a brilliant to sometimes greasy luster. It has been found at Jolster, Norway, but has not thus far been identified in the United States, unless one of the alteration products of samarskite found at the Wiseman mine, in Mitchell County, can be referred to this mineral.

Polycrase.—This mineral is principally a niobate and titanate of yttrium, erbium, cerium, and uranium similar to euxenite. Its yttrium oxide contents vary from 13 to 27 per cent. It is found usually in orthorhombic, prismatic crystals, which have a conchoidal fracture. It is black in color and of a vitreous to resinous luster. It has been found in the United States near Ironia, Henderson County, N. C., and in South Carolina about 4 miles from Marietta, Greenville County.

The demand for zircon and gadolinite is limited, for the reason that in the manufacture of the Nernst lamp there is but a very small quantity of these oxides used, and even with a very large increase in the number of Nernst lamps used there would be but a very small increase in the demand for these minerals. This, to a certain extent, is also true of monazite, although this mineral is still mined much more extensively than the other two and there is a considerably larger demand for it.

PRODUCTION.

The total production of monazite in North Carolina during 1904 amounted to 685,999 pounds, valued at \$79,438. As compared with the production of 773,000 pounds, valued at \$58,694, in 1903, this is a decrease of 87,001 pounds in quantity, but an increase of

\$20,744 in value. The above quantities represent the purified sand containing from 85 to 99 per cent. monazite. The large increase in the value of the production with the decrease in the quantity, as compared with the production of 1903, is due to the higher percentage of monazite contained in the sand prepared for market. This production was obtained from the following counties, given in the order of the importance of their productions: Cleveland, Burke, McDowell, Rutherford, and Lincoln.

The production of zircon in 1904 was 1,000 pounds, valued at \$200, and was obtained from Henderson County. This makes the total production of these minerals mined for use in the manufacture of various lamps amount to 686,999 pounds in quantity, valued at \$79,638. In the table below there is given the production and value of monazite and zircon mined in North Carolina from 1893 to 1904:

PRODUCTION OF MONAZITE AND ZIRCON IN NORTH CAROLINA
FROM 1893 TO 1904.

YEAR.	MONAZITE.		ZIRCON.	
	POUNDS.	VALUE.	POUNDS.	VALUE.
1893.....	130,000	\$ 7,600	-----	\$-----
1894.....	546,855	36,193	-----	-----
1895.....	1,573,000	137,150	-----	-----
1896.....	30,000	1,500	-----	-----
1897.....	44,000	1,980	-----	-----
1898.....	250,776	13,542	-----	-----
1899.....	350,000	20,000	-----	-----
1900.....	908,000	48,805	-----	-----
1901.....	748,736	59,262	-----	-----
1902.....	802,000	64,160	2,000	380
1903.....	773,000	58,694	3,000	570
1904.....	685,999	79,438	1,000	200

TANTALUM AND URANIUM MINERALS.

During the past few years there has considerable interest arisen regarding tantalum and uranium minerals on account of the value of tantalum for use in the manufacture of the tantalum lamp and of the relation of uranium to radium. Minerals containing tantalum and uranium have been found in a number of localities in North Carolina, and the uranium minerals have been used to some considerable extent in experimental work regarding radium. The demand for minerals containing tantalum is not large and at the present time

is limited to the amount of this metal that is used in the manufacture of the tantalum lamp. The demand for the uranium minerals depends upon their radium contents, and while at the present time there is a large demand for these minerals that are high in radio-activity, yet the market for such minerals must necessarily be, at the present time, more or less uncertain.

TANTALUM MINERALS.

The demand for tantalum in the commercial world has only arisen within the last year, and is due to the discovery that this metal is capable of withstanding the highest temperature obtained in an incandescent light and that it can be obtained of sufficient ductility to permit of being drawn into very fine wire which has little tendency to break up when heated by the electric current. The results of the investigations with tantalum by the firm of Sieman & Halske have led to the invention and manufacture of the "tantalum lamp," in which the incandescent material is tantalum wire that is capable of withstanding the highest temperatures. Although experimental work was carried on with a number of metals, it was not until tantalum was tried that a metal was found of sufficient ductility and high melting point to answer the purposes desired. After tantalum had been proved to be the metal desired for the manufacture of these incandescent lamps, it was then necessary to locate sources of supply of this metal.

There are quite a number of minerals that contain this metal, but it is nearly always associated with niobium. The most common and familiar minerals containing tantalum are columbite and tantalite, two minerals that are very closely associated with each other, and are niobates and tantalites of iron and manganese. They pass by almost insensible gradations from a normal columbite, which is the nearly pure niobate, containing about 77.9 per cent. of niobium pentoxide and but a trace of tantalum pentoxide, to normal tantalite, which is the nearly pure tantalite, containing about 84 per cent. of tantalum pentoxide and only a trace of niobium pentoxide. Of these two minerals the columbite is by far the commoner and occurs in the greater abundance. These minerals occur both massive and crystallized. The crystals are orthorhombic and usually prismatic. They are iron-black to brownish-black in color, and are frequently iridescent. They vary very considerably in specific gravity according to the increase in

- the percentage of tantalum pentoxide. The nearly normal columbite is 5.3 in specific gravity, while the nearly normal tantalite is 7.8. The common occurrence of these minerals is in pegmatitic dikes and the columbite is quite commonly found in small quantity in many of the pegmatitic dikes of western North Carolina. In some of them it has been found in considerable quantity, as in the mica mines of Mitchell and Yancey Counties, principally the Wiseman mine of Mitchell County and the Ray mine of Yancey County. At the latter mine very large crystals of columbite have been found that measure 8 x 4 x 2 inches.

There are a number of other minerals that contain tantalum, some of which might become sources of supply of this metal, but for the most part, however, they assay much smaller percentages of tantalum pentoxide than either columbite or tantalite, or else they have been found but very sparingly. There is given below a list of the principal ones of these minerals, together with their chemical composition and the principal localities at which they are known to occur:

MINERALS CONTAINING TANTALUM.

Hatchettolite.—This mineral is a tantaloniobate of uranium with calcium oxide and a small quantity of iron oxide. The percentage of tantalum pentoxide in this mineral is about 29 per cent. It is a yellowish-brown mineral, having a resinous luster and occurs sparingly, associated with samarskite, at a number of the mica mines in Mitchell County, principally the Wiseman mine.

Samarskite.—This mineral has already been described under the yttria minerals. It contains a much higher percentage of niobium pentoxide than tantalum pentoxide. It occurs in considerable quantity at the Wiseman mica mine in Mitchell County.

Microlite.—This mineral is essentially a calcium pyro-tantalate, with a considerable variety of other bases in small quantities. It is a pale yellow to brownish mineral with a resinous luster, which has been found sparingly in octahedral crystals at Chesterfield, Mass.; Branchville, Conn., and Amelia, Amelia County, Va., where it occurs in pegmatitic dikes, often associated directly with columbite. The tantalum pentoxide in this mineral is about 68.5 per cent. On account, however, of the scarcity of this mineral, it does not represent one that will be apt to become a source of supply of tantalum.

Fergusonite.—This mineral has also been described under the yttria minerals. While it usually contains but from 2 to 10 per cent. of tantalum pentoxide, occasionally specimens have been found containing as high as 27 per cent. of tantalum pentoxide. It does, however, occur in some quantity, and as a source of both yttrium oxide and tantalum it may become of some considerable commercial value.

Tapolite.—This mineral is essentially a tantalate and niobate of iron. It has thus far been observed in but one locality near the village of Sukala,

Finland. It has been observed but sparingly and occurs in pyramidal, tetragonal crystals of a pure black color and a strong, adamantine luster. Its percentage of tantalum pentoxide is 73.9.

Yttrotantalite.—This mineral has been described under the yttria minerals. Besides the yttrium oxides, it contains 46.25 per cent. of tantalum pentoxide, and is another one of those minerals that might become a source of both the yttrium oxides and tantalum. It is, however, of rather rare occurrence, having been found at but few localities in Sweden, principally at Ytterby.

Hielmite.—This rare mineral is essentially a stannotantalate of yttrium, iron, manganese, and calcium, and has been found very sparingly at the Kararfvet mine, near Falun, Sweden. Its color is pure black, and it has a metallic luster. It occurs usually massive, without any apparent cleavage, but occasionally it is in rough, orthorhombic crystals. It contains from 54 to 72 per cent. of tantalum pentoxide.

URANIUM MINERALS.

All of the uranium minerals have become of special interest within the past few years, since the discovery of radium. This is especially true since uranium has been shown to be the direct source of radium. In the article on the "Origin of Radium"* referred to above, it has been shown that uranium is the source of radium and that there is a constant proportionality between the uranium and the radium in the various minerals containing these elements. There was a series of 22 uranium minerals examined for their uranium and radium contents, including specimens from very widely separated localities, and specimens that varied very widely in their percentage of uranium. In the following table the results obtained in the examination of these uranium minerals are given. Column I gives the activity of the emanations contained in one gram of the mineral; column II, the activity of the emanation lost by one gram of the mineral at ordinary temperatures; column III, the sum of the two previous activities (total emanation equivalent to the radium content in one gram of the mineral); column IV, the percentage of the total emanation lost by diffusion from the cold mineral (the emanating power of the mineral at ordinary temperatures); column V, the weight (in grams) of the uranium content in one gram of mineral; column VI, the ratio of the radium to the uranium (the number obtained on dividing the total activity, column III, by the quantity of uranium, column V).

*Philosophical Magazine of London, April, 1905, p. 599.

**COMPARATIVE RESULTS OBTAINED IN THE EXAMINATION OF
MONAZITE AND OTHER MINERALS.**

No. of Specimen.	Substance.	Locality.	I.	II.	III.	IV.	V.	VI.
1	Uraninite	North Carolina	150.7	19.3	170.0	11.3	0.7465	228
2	do	Colorado	147.1	8.0	155.1	5.2	.6961	223
3	Gummite	North Carolina	126.7	20.3	147.0	13.7	.6538	225
4	Uraninite	Joachimsthal	131.8	7.8	139.6	5.6	.6174	226
5	Uranophane	North Carolina	108.0	9.7	117.7	8.2	.6168	228
6	Uraninite	Saxony	112.5	3.1	115.6	2.7	.5064	228
7	Uranophane	North Carolina	88.8	24.7	113.5	22.8	.4964	228
8	Thorogummite	do	61.1	11.8	72.9	16.2	.3317	220
9	Carnotite	Colorado	41.6	8.1	49.7	16.3	.2261	220
10	Uranothorite	Norway	24.9	.3	25.2	1.3	.1138	221
11	Samarskite	North Carolina	23.2	.16	23.4	.7	.1044	224
12	Orangite	Norway	22.84	.28	23.1	1.1	.1034	223
13	Euxenite	do	19.8	.10	19.9	.5	.0871	228
14	Thorite	do	15.6	1.0	16.6	6.2	.0754	220
15	Fergusonite	do	11.95	.07	12.0	.5	.0557	215
16	Aeschnynite	do	9.98	.02	10.0	.2	.0452	221
17	Xenotime	do	1.14	.40	1.54	26.0	.0070	220
18	Monazite	North Carolina	.88	.00	.88		.0043	205
19	do	Norway	.84	.01	.85	1.2	.0041	207
20	do	Brazil	.76	.00	.76		.0034	223
21	do	Connecticut	.63	.00	.63		.0030	210
22	Allanite	North Carolina	.014	.00			(0.00007)	

From the data given in the table it is evident that a direct proportionality (within the limits of experimental error) exists between the quantities of radium and the quantities of uranium, and the inevitable and only possible conclusion is that uranium is the parent of radium. The participation by thorium in the production of radium, which has been suggested by some, is entirely excluded, since the radium-uranium ratio in the thorites, containing approximately 50 per cent. of thorium, is the same as that in such minerals as carnotite and uranophane, where the content of thorium is not over a few hundredths of a per cent. at the highest.

As is seen from the above table, of the 22 specimens examined 8 were from North Carolina. It is interesting to note that the uraninite, specimen No. 1, which was from the Flat Rock mine, Mitchell County, showed the highest radio-activity of any of the minerals examined.

The sources of supply of these uranium minerals in North Carolina have been confined almost entirely to the pegmatitic dikes of Mitchell and Yancey counties, the former having produced the greatest amount. The mine that has produced the largest quantity of uranium minerals is the Flat Rock mine, near Spruce Pine, Mitchell County. Other mines that have produced smaller amounts of uranium minerals are the Buchanan, Wiseman, and Deake mines, in Mitchell County, and the Ray mine, Yancey County. As far as

can be judged from the work done on the pegmatitic dikes containing these uranium minerals, none of them contain them in sufficient quantity to be worked for these minerals alone. When, however, they are operated as sources of mica, the uranium minerals would be obtained as valuable by-products.

There are many minerals containing uranium that are known at the present time, but they are for the most part found but sparingly and some of them are only known from one locality. The only ones that have been found in sufficient quantity to become a source of uranium are uraninite, gummite (an alteration product of uraninite) and carnotite. The first two have been found in some quantity in the western part of North Carolina, but the third was identified and described from Colorado, and has thus far only been found in a few places in Colorado and the adjoining counties of Utah.

Uraninite, or, as it is more commonly known, pitchblende, is a uranate of uranyl and lead, with usually thorium (or zirconium), and sometimes with the metals of the lanthanum and yttrium groups. Certain varieties contain nitrogen, and several of the newly discovered and rare elements, as helium, radium, and polonium. This mineral is usually massive and botryoidal, with a conchoidal to uneven fracture, and is brittle. Crystals are rare, the octahedron being the common form. It has a hardness of 5.5 and a specific gravity of 9 to 9.7. In appearance it is often pitch-like, having a submetallic to greasy and dull luster, and a grayish, greenish-black to velvet-black color.

Uraninite, which is the name given to the crystallized variety, occurs as a constituent in many pegmatitic dikes and coarse granites, and is the variety that generally carries the rare earths and nitrogen. The massive variety, pitchblende, usually contains none or but a very small amount of the rare earths and nitrogen, and is more commonly found as an associate in metalliferous veins, with the sulphides of silver, lead, copper, nickel, iron, and zinc.

Uraninite suffers alteration quite readily, going over into the hydrated mineral, gummite, which looks like gum, and whose exact composition is not known. Crystals of gummite are observed only as pseudomorphs after uraninite; and it is more often in rounded or flattened pieces, with a greasy luster and a reddish-yellow to orange, hyacinth-red or reddish-brown color, the brighter colors being the more prominent. It is only 2.5 to 3 in hardness and has a specific

gravity of 3.9 to 4.2. As would be naturally expected, gummite is to be found at nearly all the uraninite localities, masses of this mineral often being found as a distinct mineral. A further alteration of the uraninite, through gummite, is to the mineral uranophane or uranotil, which is found in masses of a fine fibrous structure, with a vitreous luster and a honey-yellow, lemon, or straw-yellow color. It is a hydrous silicate of calcium and uranium, and besides being found as an alteration product, it also occurs as a distinct mineral. It is not uncommon to find the uranophane surrounding a mass of gummite, in the center of which is a nucleus of uraninite.

In the following table the name and composition of the minerals containing uranium in sufficient amount to classify them as uranium minerals are given, and those that have been identified in North Carolina are in italics:

LIST OF MINERALS CONTAINING URANIUM.

Uraninite.—Described above.

Gummite.—Described above.

Uranophane (or Uranotil).—Described above.

Uranothallite, a hydrous calcium uranium carbonate, $2\text{CaCO}_3 \cdot \text{U}(\text{CO}_3)_2 \cdot 10\text{H}_2\text{O}$, occurs very sparingly as an incrustation of a siskin-green color on uraninite.

Liebigite, a hydrous calcium uranium carbonate, formula perhaps $\text{CaCO}_3(\text{UO}_2)\text{CO}_3 \cdot 2\text{OH}_2\text{O}$, occurs rarely as an apple-green crystalline incrustation on uraninite.

Vogllite, a hydrous carbonate of uranium, calcium, and copper, of an emerald-green to grass-green color, is sparingly found in aggregates of crystalline scales implanted on uraninite.

Schröckingerite and randite are two uranium calcium carbonates of uncertain composition.

Some of the varieties of thorite contain a considerable quantity of uranium as uranothorite, which carries over 9 per cent. of uranium oxide, U_2O_5 , and is found in the Champlain iron district, New York, but whose exact locality is unknown.

A number of the niobium and tantalum minerals contain from 2 to 15 per cent. uranium oxide. They are, in the order of their percentage of uranium: Blomstrandite, *hutchettolite*, *samaraskite*, *polycrase*, *euxenite*, *fergusonite*, *ytrotantalite*, *annerödite*, and *hielmit*.

Uranosphaerite, a hydrous bismuth uranate (BiO_2), $\text{U}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$ occurs sparingly in half-globular aggregated concentric forms of an orange-yellow color.

Torbernite, a hydrous phosphate of uranium and copper, $\text{Cu}(\text{UO}_2)_2 \cdot \text{P}_2\text{O}_5$, occurs in foliated micaceous aggregates of an emerald to grass-green color, closely resembling autunite.

Zeunerite is a hydrous copper uranium phosphate, $\text{Cu}(\text{UO}_2)\text{As}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$, similar in appearance to torbernite.

Uranosplinite is a hydrous calcium uranium arsenate, probably $\text{Ca}(\text{UO}_2)_2\text{As}_2\text{O}_7 \cdot 8\text{H}_2\text{O}$, and similar to autunite, but rare.

Uranocircite is a hydrous barium uranium phosphate, $\text{Ba}(\text{UO}_2)_2\text{P}_2\text{O}_7 \cdot 8\text{H}_2\text{O}$, similar to autunite, but very rare.

Phosphuranylite, a hydrous uranium phosphate, $(\text{UO}_2)_2\text{P}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$, sometimes carrying lead, is found sparingly as a deep lemon-yellow incrustation on quartz and feldspar at some of the uraninite localities.

Trögerite, a hydrous uranium arsenate, $(\text{UO}_2)_2\text{As}_2\text{O}_7 \cdot 12\text{H}_2\text{O}$, in thin lemon-yellow crystals, has been found very sparingly at the Bald Mountain mining district, Black Hills, South Dakota.

Fritzscheite, a mineral resembling autunite, but of a reddish color, which is attributed to manganese, is of doubtful composition, but shows reactions for uranium, vanadium, manganese, phosphorus, and water.

Walpurgite, a basic arsenate of bismuth and uranium, $\text{Bi}_{10}(\text{UO}_2)_2(\text{OH})_2(\text{AsO}_4)_6$, is very rare.

Johannite is a hydrous sulphate of uranium and copper, of a beautiful emerald-green color.

Uranopillite, a hydrous calcium uranium sulphate, perhaps $\text{CaU}_2\text{S}_2\text{O}_{14} \cdot 25\text{H}_2\text{O}$, has been found as a velvety incrustation of a yellow color on uraninite.

Uraconite, or uranocher, is an amorphous earthy mineral of a fine lemon-yellow color, whose composition is principally a hydrous uranium sulphate.

Medjidite, uranochalcite, zippeite, and voglianite are uranium sulphates of uncertain composition, containing from 36 to 79 per cent. of uranium oxides.

PRODUCTION.

There was a small production of uranium minerals during 1904 from some of the mines in Mitchell County, obtained principally from working over the old dumps of the Flat Rock mine. The value of these uranium minerals obtained was approximately \$160, consisting principally of uraninite and gummite.

TALC AND SOAPSTONE.

INTRODUCTION.

Talc is one of the more prominent minerals that is being mined in North Carolina and, on account of the quality of talc that certain of the mines produced, it is widely known and in greater demand than the mines can supply. This talc is that which is found in Swain County, principally at the Hewitt mine, it being very pure and sufficiently compact so that it can be used for the manufacture of tailor's pencils, gas tips, etc. These deposits are unique, and there are no others known at the present time in the United States that can furnish talc of this quality. Inquiries are constantly being received regarding talc and soapstone deposits, most of which refer to a talc of superior

quality like that obtained from the Hewitt mine, and also for a talc that is sufficiently pure for grinding into flour talc for use in the manufacture of talcum powder. Thus, any deposit in the State that contains talc of the right quality for this purpose is worthy of sufficient development work to prove the quantity of the mineral. Talc of such quality brings a good price and does not have to be as favorably located for transportation facilities as the inferior grades and soapstone varieties.

The inferior grades of talc, even though they can be used in the powdered condition for certain purposes, as certain soapstones and pyrophyllite, are not in as large a demand and of course command but a low value as compared with the other quality, and are used principally for foundry facings.

The soapstone variety of talc is sometimes ground to a flour talc and used for foundry facings in the manufacture of paper, etc.; but its principal use is in the manufactured articles, such as tubs, table tops, griddles, ovens, etc. There is but very little of this variety of talc that is utilized in North Carolina on account of the distance of the deposits from railroad transportation. It is, however, used in some amount each year in the mountain counties, principally Alleghany, Ashe, Mitchell, and Yancey, for fire-places, chimneys, etc.

PRODUCTION.

The total production of talc and soapstone of all varieties in North Carolina during 1904 amounted to 3,801 tons, valued at \$65,483. As compared with the production of 1903, of 5,331 short tons, valued at \$76,984, this is a decrease of 1,530 tons in quantity and of \$11,501 in value. The large decrease in tonnage is due principally to the large falling off in the production of the pyrophyllite variety of soapstone from Moore County. The counties making this production of talc in 1904 were Swain, Moore, Cherokee, Jackson and Ashe, given in the order of the importance of their productions, there being a total of five producers, exclusive of those quarrying stone for fire-places and chimneys. The soapstone quarried for fire-places, etc., was obtained principally from Ashe County.

The value of the talc production given above includes that of the manufactured products made from talc, as there is but a small quantity of the production that is sold in the crude state. The production is classified, therefore, as it is marketed as rough, manufactured,

ground, and for chimney purposes. In the following table the conditions in which the 1904 production was marketed is shown, together with that for the years 1902 and 1903:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1901, 1902 and 1903.

CONDITION IN WHICH MARKETED.	1902.		1903.		1904.	
	QUAN- TITY, SHORT TONS.	VALUE.	QUAN- TITY, SHORT TONS.	VALUE.	QUAN- TITY, SHORT TONS.	VALUE.
Ground talc for powders, etc.	3,381	\$ 31,628	3,762	\$37,606	3,163	\$ 32,217
Talc cut into pencils, gas tips, etc.	371	42,017	265	27,615	206	28,673
Talc sold crude	1,487	15,317	1,304	11,763	430	4,417
Soapstone cut into slabs for chimneys, etc.						175
Total	5,239	88,962	5,331	76,984	3,801	65,483

In the table below there is given the quantity and value of talc and soapstone produced in North Carolina from 1898 to 1904, inclusive.

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1904, INCLUSIVE.

YEAR.	QUANTITY.	VALUE.	YEAR.	QUANTITY.	VALUE.
	<i>Short Tons.</i>			<i>Short Tons.</i>	
1898	1,695	\$ 27,320	1901	5,819	\$ 77,974
1899	1,817	31,880	1902	5,239	88,962
1900	4,522	75,308	1903	5,331	76,984
			1904	3,801	65,483

PRECIOUS STONES.

There are few States that furnish the variety of precious stones, or gem minerals that are found in North Carolina. Some of these minerals are of special interest, as they have thus far been found only in this State. These are rhodolite, which has only been found in Macon County, and hiddenite, which has only been found in Alexander County.

Perhaps the more common and popular use of the terms gem, gem mineral, and precious stone is in their application to the precious and semi-precious minerals which are suitable for cutting into gems to be used in jewelry. This, however, is a somewhat restricted use of these terms as they are now used in the arts. The names, gem mineral or precious stone, are at the present time given to those minerals which are either suitable for cutting into gems for jewelry; or are used in various polished forms as ornaments; or are of a rare occurrence and make striking and beautiful mineral specimens. For instance, in illustrating the first class, the diamond, ruby, sapphire, etc., could be cited; representatives of the second class would be the minerals malachite, serpentine, quartz, etc.; while of the third class there would be rhodochrosite, pyrite, etc. The gem minerals constituting the first class are, of course, the most important and will demand the most attention.

There has been but little systematic mining for precious stones in North Carolina, and the only two companies who have really engaged in mining for these stones are the American Gem and Pearl Company, of New York, and the American Gem Mining Syndicate, of St. Louis, whose properties are located in Mitchell and Macon counties respectively. The former produced many varieties of beryl and the latter rhodolites, a variety of garnet.

The principal minerals which have been found in North Carolina that are valuable as gems are:

Diamond.	Opal.
Corundum (7 varieties).	Peridot (Olivine).
Almandite (Garnet).	Spinel Ruby.
Rhodolite (Garnet).	Gahnite.
Pyrope (Garnet).	Zircon.
Beryl (3 varieties).	Tourmaline.
Hiddenite.	Rutile.
Quartz (12 varieties).	Oligoclase (Moonstone).
Cyanite.	Staurolite.

The gem minerals that offer the greatest possibilities commercially are beryls, garnets, hiddenite, and corundum minerals, including ruby, sapphire, etc.

GARNET.*

Garnet is a name given to a group of minerals that have very similar physical properties, except color, but are different in chemical

*For a more detailed description of the gem minerals of North Carolina, see *The Southland*, Vol. I, p. 1, and *Bulletin of N. C. Geological Survey*, now in press.

composition. They crystallize in the isometric system with the dodecahedron and the tetragonal tris-octahedron as the most common simple forms. They are all orthosilicates of calcium, magnesium, iron or manganese with aluminum, iron, or chromium. In the following table are given the different varieties of garnets that have been recognized:

I. ALUMINOUS GARNETS.

Grossularite (Essonite)	$\text{Ca}_3\text{Al}_2(\text{SiO}_4)_3$
Pyrope	$\text{Mg}_3\text{Al}_2(\text{SiO}_4)_3$
Rhodolite	$2\text{Mg}_2\text{Al}_2(\text{SiO}_4)_2\text{Fe}_2\text{Al}_2(\text{SiO}_4)_2$
Almandite	$\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$
Spessartite	$\text{Mn}_3\text{Al}_2(\text{SiO}_4)_3$

II. IRON GARNET.

Andradite (Demantoid)	$\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$
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III. CHROMIUM GARNET.

Uvarovite	$\text{Ca}_3\text{Cr}_2(\text{SiO}_4)_3$
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Of the above, the essonite, pyrope, rhodolite, almandite and uvarovite constitute the members of the garnet group that are used for gems. There is, however, a green variety of the andradite, known as demantoid, that has been found in the Ural Mountains, that is used as a gem.

Essonite.—This garnet is also known as cinnamon garnet or cinnamon stone and hyacinth of the jeweler (although the true hyacinth is a zircon). It has been found in beautiful transparent, flat crystals between plates of mica near Bakersville, North Carolina, some of which would cut into gems of a carat or more in weight.

Pyrope.—This variety of garnet has been found in Burke, McDowell, and Alexander counties, in the gravels of the gold and placer deposits. These are of a nearly blood-red color and have furnished some good gems.

Almandite.—This is one of the commonest of the gem garnets and varies in color from a pinkish or scarlet, through brownish-red to deep red. These have been found very extensively in North Carolina and Georgia, especially in Burke and Caldwell counties. Some of these garnets have weighed 20 pounds, and although they were not of sufficient purity to be cut into gems, they might be used for cutting into dishes. Those of gem quality would only furnish very small stones. A great deal of this garnet has been used in the manufacture of sandpaper or garnet-paper. Near Hall Station, Jackson County, North Carolina, an almandite garnet occurs in the gneissic rock, from

which it is separated and used in the manufacture of garnet wheels for abrasive purposes. When the scarlet and crimson varieties are cut *en cabochon* they are sometimes called carbuncles.

Rhodolite.—This garnet is remarkable for its color and beauty as a gem stone. It has a peculiar and beautiful tint that in part belongs to that of the rhododendron and the rose, and this, combined with its transparency and brilliancy, is most striking in artificial light. Most garnets are beautiful only by transmitted light and then are apt to exhibit only dark shades of color, but the rhodolite gives the most beautiful effects of brilliant and varied coloring by reflected light. It has been found only in Macon County, North Carolina, in the streams which head in Mason's Mountain and in places on this mountain. Some stones have been cut that were as high as $13\frac{3}{8}$ carats in weight.

None of the green garnets have as yet been found in North Carolina.

The garnets are very common in their occurrence and are apt to occur abundantly in crystals or rounded grains, in mica schists, gneiss, granite, and sometimes crystalline limestone. In the pegmatitic dikes or granitic veins which are the source of mica, garnet is usually quite abundant, and in many of the mica mines extending from Virginia through North Carolina, Georgia, and Alabama, garnets of gem quality have been found. Many of the garnets found in these veins are the andradite varieties.

During 1904 garnet was one of the principal precious stones mined.

BERYL.

Beryl is a silicate of beryllium and aluminum and crystallizes in the hexagonal system, usually in well-developed six-sided prisms. In color it varies from emerald green, pale green to sea green, passing into yellow, light blue, and white. The emerald-green color is due to the presence of a little chromium, and is a variety that is highly prized as a gem when clear and free from flaws. The beryl emerald is the emerald that is commonly sold at the present time, the oriental or true emerald (the green variety of sapphire) being one of the rarest of the gem stones. The finest emeralds are found in New Grenada and Siberia. The South has furnished some very handsome beryls of emerald-green color, some of which have cut into fine stones. The most noted locality is near Hiddenite, Alexander County, North Caro-

lina. The general surface of the country is rolling, having an average altitude of about 1,000 feet above sea-level. The rocks are covered by 25 or more feet of soil, which has resulted from the decomposition of a gneissic rock which underlies it. The first emeralds that were obtained at this locality were found in the soil, and it was not until 1881, when the Emerald and Hiddenite Mining Company was organized, that any direct mining was undertaken. The location of the deposits favorable to these gems is recognized by the float, quartz crystals, and mica observed on the surface, for these have only been slightly moved from the place where they originated. As the deposits were followed downward through the soil the unaltered rock was encountered, and as the work was extended into this, their exact occurrence was seen. They occur in pockets of quartz, associated with rutile, hiddenite, quartz, muscovite, dolomite, pyrite, garnets, etc., all of which are well crystallized. The rutile found here is the finest that has been observed in any locality in the world. The quartz associated with the emeralds is exceptionally well crystallized and has furnished some of the most modified crystals ever found. It has been observed that most of the emeralds have been found where the quartz crystals are not so highly modified (although they are well crystallized), and the hiddenite occurs with the quartz, which does not show these many modifications. These pockets vary from some that are simply a slight widening of a seam of quartz to the average, which are about 6 inches wide and a foot to 18 inches long, to one that was open, which was large enough for a man to enter. The rock, which is gneissoid in character, is scarred by small seams of quartz, many of which have a nearly east and west strike and dip toward the north. The seams are usually very narrow, from half an inch to an inch or two in width, and as these are followed downward, they broaden very considerably just before a pocket is encountered. There are other seams of quartz in these rocks that are very irregular in strike and dip, and none of this character have as yet been observed that have developed into pockets containing gems. The largest emerald crystal found here was a very perfect specimen of a fine but somewhat light-green color which has doubly terminated and weighed $8\frac{3}{4}$ ounces. One of the largest stones cut weighed 4 23-32 carats and was of a somewhat light-green color.

On Crabtree Mountain, between Brush and Crabtree Creeks, Mitchell County, emerald beryl occurs in a pegmatitic vein. No

very large crystals have as yet been found at this locality, but some have been taken out that have cut small gems of a deep emerald color. The most satisfactory results have been obtained by cutting the emerald in the matrix, *en cabochon*. These have attracted considerable attention and they make very attractive stones.

The aquamarine variety of beryl is found very commonly in many of the pegmatitic dikes that have been worked for mica in Virginia and North Carolina. The most important of these are the Wiseman mine, Mitchell County; the Ray mine, Yancey County, and the Littlefield mine, Macon County, where transparent aquamarine beryls have been found very abundantly that have cut many beautiful gems. Besides the aquamarine, blue beryl has been found in fine crystals in the mines of Mitchell County near the Yancey County line, as has also yellow or golden beryl. The Wiseman mine, near Spruce Pine, Mitchell County, has produced the greatest quantity of aquamarine, golden, yellow, and blue beryls. This mine has been operated by the American Gem and Pearl Company, of New York, who were the largest producers of precious stones in the State during 1904. The largest pieces of beryl found during this year would not cut stones much over 10 carats in weight, although some pieces have been found that cut stones over 20 carats in weight.

CORUNDUM GEMS.

As a gem mineral corundum is very prominent, as it furnishes not only a variety of gems, but also some of the rarest. This mineral varies very widely in color, being found ruby red, sapphire blue, dark blue, various shades of green, violet purple, rose, pink, brown, yellow, gray, colorless, and black. The corundum gems are determined by the color and there are at the present time nine varieties that are commonly recognized by the lapidaries. In the arts the principal ones are usually prefixed by the word "oriental" to distinguish them from other gems called by the same name, but whose mineral composition and characteristics are entirely different. These nine varieties of corundum gems are given in the following table:

<i>Name.</i>	<i>Color.</i>
Oriental or True Ruby.....	Pigeon blood, red and shades of red.
Oriental Sapphire.....	Corn flower blue and shades of blue.
Oriental Emerald.....	Green.
Oriental Amethyst.....	Purple.
Oriental Topaz.....	Yellow.

Pink Sapphire.....	Rose or pink.
White Sapphire.....	Colorless.
Diamond Spar.....	Colorless.
Girasol	Pale blue or bluish white.
Opaline	Pale blue or bluish white.
Hyaline	Pale blue or bluish white.
Star Sapphire.....	Opalescent.
Chatoyant	Opalescent.
Asteria	Opalescent.

All these varieties of corundum gems have been found in North Carolina, although some of them have been found but very rarely, while others occur in some quantity.

Rubies of good color and even of the pigeon-blood color have been found at the Corundum Hill mine, Macon County, and in Cowee Valley, Macon County. The former locality has furnished a greater variety of corundum gems than any other, these having been found of ruby color, various shades of green, yellow, blue, pink, and colorless. At the latter locality the prevailing color is a ruby red.

The best sapphires have been found at the Corundum Hill mine, Macon County, and the Sapphire and White Water mines, Jackson County.

With the exception of the mining for rubies in Cowee Valley, there has not been any systematic mining for corundum gems in the State. The Corundum Hill mine offers some possibilities of furnishing various gems of some considerable value, if mining were conducted particularly for them.

HIDDENITE.

This gem mineral has only been found at the emerald (beryl) locality at Hiddenite, Alexander County, which has been described above. This gem is the green variety of spodumene, the pink variety being known as kunzite. On account of the rarity of this gem and because the locality has not been worked for many years, the gems are valued and sold at fabulous prices.

OTHER GEM MINERALS.

Amethysts are obtained in many localities, but for a number of years there has not been any definite mining for them, although a few are obtained each year from Iredell, Lincoln, and Macon counties. Perfectly clear, colorless quartz and smoky quartz also occur in some abundance, and crystals and pieces are constantly being

found and sold, chiefly as mineral specimens. Rutile, zircon, and cyanite of sufficient purity to cut into gems are also occasionally found, although most of the material is only of value as mineral specimens.

PRODUCTION OF PRECIOUS STONES.

The total value of the production of precious stones of all kinds in North Carolina during 1904 amounted to \$10,600, which is an increase of \$9,075 as compared with \$1,525, the value of the 1903 production.

In the following table is given the production of precious stones in North Carolina since 1900:

PRODUCTION OF PRECIOUS STONES
IN NORTH CAROLINA SINCE 1900.

YEAR.	VALUE.
1900	\$ 12,020
1901	24,245
1902	5,300
1903	1,525
1904	10,600

GRAPHITE.

On account of the many uses for which graphite is adapted, and because the large demand for this mineral is only partly supplied by that produced in the United States, it is a mineral that has always attracted considerable interest in the mining industry. Although graphite is mined in only a very small amount in North Carolina, yet on account of the large demand for it and from the fact that there are numerous occurrences of this mineral throughout the State, it is one of the minerals regarding which inquiries are constantly being received. The pure mineral is composed simply of carbon, but is often impure from the presence of iron sesquioxide, clay, mica, etc. Even the purest forms of graphite, as they are found in nature, will yield upon combustion from a fraction of 1 per cent. upward in ash. Some of the graphite from the Ticonderoga (New York) deposits has given as low as 0.24 of 1 per cent. of ash. This mineral crystallizes in the rhombohedral division of the hexagonal system, and, when crystallized, is usually in six-sided tabular crystals that are nearly al-

ways striated and whose faces are indistinct. It is commonly found in embedded, foliated masses, or in scaly, slaty, or micaceous masses; occasionally it is in granular to compact formation, and at other times it is of a decidedly earthy texture. It has a perfect basal cleavage, similar to a mica, and the thin laminae are flexible, but not elastic. Graphite varies considerably in specific gravity— from 2.09 to 2.23— according to the amount of impurities. The hardness also varies, for the same reason, from 1 to 2. Graphite has a metallic luster when pure, and varies from this to dull and earthy, according to the percentage of impurities. The color, for the same reason, also varies from iron-black to dark steel-gray. It has a greasy feel, is a conductor of electricity, is impervious to atmospheric influences, is combustible only at very high temperatures, and is very soft. It is these properties of graphite that make it of so much value in the arts and adapt it to such a large variety of uses.

The sources of supply of graphite in the United States have been chiefly deposits in New York, Pennsylvania, Wisconsin, Michigan, Alabama, Rhode Island, Georgia, and Ohio. It has, however, been found in small quantities in nearly all of the western and eastern States. The foreign localities, which furnish over three times what is produced in this country, are principally in the Island of Ceylon, which produces a crystalline graphite, and from Austro-Hungary, which produces an amorphous graphite. A very small amount is obtained from Mexico.

USES.

The uses of graphite are very numerous and varied. One of the chief uses is in the manufacture of crucibles, retorts, and other refractory apparatus, and for this purpose it is the crystalline variety that is most extensively used. It has been estimated that 55 per cent. of the crystalline graphite is used for this purpose and only a very small percentage of the amorphous variety. Other uses of the crystalline graphite are as follows: About 15 per cent. of the total production for the manufacture of stove polishes, about 10 per cent. for foundry facings, about 5 per cent. for paint (the bulk of the graphite used for this purpose being of the amorphous variety), and 15 per cent. in the manufacture of pencils, powder glaze, electrotyping, steam packing, and electrical supplies. With the exception of the Georgia amorphous graphite, which is used in coloring fertilizers,

the bulk of the amorphous graphite mined is used in the manufacture of paint and for foundry facings.

In the manufacture of good grades of pencils, lubricants, electrical supplies, and crucibles, it is essential that a nearly pure graphite be used, this being especially true of the lubricants and of the best quality of pencils. For paints and foundry facings, purity is not so essential, and therefore the amorphous varieties can be used with as good results as the crystalline. The uses of graphite as a lubricant have been constantly increasing, and now there are many forms of graphite lubricants on the market. Many reasons are advanced for the more universal introduction of graphite as a lubricant, such as the fact that graphite permanently fills up all the minute irregularities or roughnesses on metal surfaces, thus making them absolutely smooth and even; that it also reduces frictional resistance; is not crushed or squeezed out by great pressures; prevents sizing and cutting; is unaffected by any degree of heat that would be attainable in a cylinder or bearing; is not decomposed by the action of anything to which it would be subjected, and that it does not corrode metals with which it would come in contact. It must, however, be an absolutely pure graphite, without any gritty matter or iron oxide in it. About 1,200 tons of amorphous graphite are used in the manufacture of paints. In some of the States the whole production of graphite is used for this purpose, while in others the whole production is used for foundry facings. Only a few of the producers utilize the graphite themselves for manufacture into commercial products, and it is usually sold direct by the miners or producers to the manufacturers of paint or to foundrymen.

Besides the crystalline and amorphous graphite, there is the artificial graphite, which nearly equals in quantity the production of crystalline graphite in this country. This product is used in the manufacture of electrical supplies, pencils, crucibles, and the other various purposes for which the natural graphite is used.

PRODUCTION.

There was but a small production during 1904, all of which was obtained from Wake County, amounting to 100 tons, valued at \$525. This is an increase of 50 tons in quantity and of \$277 in value as compared with the production of 50 tons, valued at \$248, in 1903. This, however, is a decrease of 730 tons in quantity and of \$3,775 in

alue as compared with the production of 830 tons, valued at \$4,300, in 1902. These graphite deposits are low grade and do not furnish the finer grades of commercial graphite for which there is the greater demand. These deposits have been described in detail in previous reports.*

In the following table there is given the production of graphite from 1901 to 1904:

PRODUCTION OF GRAPHITE IN NORTH CAROLINA FROM 1901 TO 1904.

YEAR.	QUANTITY.	VALUE.
	<i>Tons.</i>	
1901	95	\$ 559
1902	830	4,300
1903	50	248
1904	100	525

The total production of graphite in the United States during 1904 was 21,955 tons, valued at \$341,372, of which only about 6,000 tons were used for the ordinary purposes of graphite, the bulk of the production being used as a coloring material in the manufacture of fertilizers. This graphite, however, was valued at only about \$1.25 per ton. Besides this natural production of graphite in the United States, there was also manufactured 1,624 tons, valued at \$217,790, of artificial graphite, practically all of which was consumed in the United States. To this should be added the amount of graphite imported into the United States, which, during 1904, was 12,674 tons, valued at \$905,681, making the total amount of graphite consumed in the United States 37,627 tons, valued at \$1,452,326. If there is deducted from this figure the amount of graphite used as a coloring material in fertilizers, it leaves the total consumption of graphite 2,627 tons, valued at \$1,431,326. The above illustrates the importance of the graphite industry and shows the quantity and value of this material that is used each year in the United States.

Thus any graphite deposit that may be located in North Carolina is worthy of sufficient development in order to determine whether it contains a sufficient quantity of this mineral to make it a commercial proposition.

*N. C. Geological Survey, Economic Paper No. 6, 1901, p. 68, and Economic Paper No. 8, 1903, p. 48.

COAL.

The coal fields of North Carolina are confined principally to Chatham and Stokes counties, the coal measures in each district being associated with the Triassic sandstones. Neither of these fields is extensive or capable of being developed into very large productive properties. The Chatham County deposits have been the most extensively developed and are the only ones that have been thus far worked on a commercial scale, and those that have been worked for the past few years are the Cumnock mines. The coal measures of Stokes County are near Walnut Cove, and they have been prospected to a considerable extent, but no systematic development work has been undertaken to accurately determine their real value nor the quantity of coal. Seams of coal have been exposed in this district that were 5 feet wide, containing 3 feet of a hard, compact coal, and the other two feet running more into fines. No work was done on these Walnut Cove deposits during 1904 beyond a little desultory prospecting.

PRODUCTION.

The quantity of coal produced in North Carolina during 1904 was only 7,000 tons, valued at \$8,820, as compared with the production of 17,309 tons, valued at \$25,300, in 1903. This is a decrease of 10,309 tons in quantity and of \$16,480 in value. In the following table there is given the quantity and value of coal produced in North Carolina from 1900 to 1904:

PRODUCTION OF COAL IN NORTH CAROLINA FROM 1900 TO 1904.

YEAR.	QUANTITY.	VALUE.
	<i>Tons.</i>	
1900	18,000	\$ 22,500
1901	3,723	5,585
1902	23,000	24,500
1903	17,309	25,300
1904	7,000	8,820

STONE.

INTRODUCTION.

Stone suitable for building purposes occurs very abundantly throughout North Carolina and is of great variety, although at the present time there are but few deposits that have been thoroughly developed and operated. The stones that are now being utilized, either for building purposes or for making roads, are granite, which includes various types of granites, gneisses and associated crystalline, siliceous rocks; sandstones and quartzites; marbles and limestones. Besides these, there are dikes of basic, intrusive rocks, including principally diabase and diorite, which have been quarried and utilized to some extent for road purposes. The slates and serpentines, which occur quite abundantly in certain portions of the State and of good quality, have not as yet been developed to any great extent.

As the above stones are quarried, there will be noted considerable variation in their color and texture, which may often make the stone undesirable and objectionable, while at other times the color of the stone may be its most desirable characteristic and increase its value considerably over an equally good and desirable stone of a different color. A stone must also be able to withstand exposure to weather without crumbling, rusting or flaking, if it is to give the best satisfaction and be able to compete with other stones. In determining whether a stone is available for building purposes, consideration must be given to its quantity; ease and cheapness with which it can be quarried; its distance from market; and its transportation facilities.

On account of the comparative low price of stone when it is weighed, it is very important that it have ready and easily accessible means of transportation, for stones prepared for building purposes are very heavy and, therefore, expensive to handle. It will also be found that in working stone of the same variety, but from different quarries, that a wide difference will be observed in the ease with which the stone can be quarried, cut and prepared for building purposes. In general it may be said that a stone of fine and even grain will work more readily than one that is coarse.

There is now in press, as Volume III of the publications of the North Carolina Geological Survey, a volume on the "Building Stones of North Carolina," which takes up in detail a description of the various stones that are found in the State, with descriptions of occurrences, localities, etc.

Although there are so many deposits of stone throughout the State suitable for building purposes, there has been little or no advance made in the development of these deposits during the past two years, except at two or three localities, which are described beyond under the heads of the different stones. In 1904 the total value of the production of all kinds of stone in North Carolina was considerably less than it has been for the past three years. During 1904 the value of the total production of building stones was \$312,576, which, as compared with \$360,322, the value of the production of 1903, is a decrease of \$47,746.

There is given in the following table the value of the production of the various stones quarried in 1902, 1903, and 1904:

PRODUCTION OF BUILDING STONE DURING 1902, 1903, AND 1904.

STONE.	1902.	1903.	1904.
	VALUE.	VALUE.	VALUE.
Granite	\$ 338,749	\$ 334,357	\$ 292,439
Sandstone	4,825	600	250
Marble and Limestone....	23,153	25,365	19,887
Total.....	\$ 366,727	\$ 360,322	\$ 312,576

GRANITE.

Granite is very widely distributed through certain areas of the State, but there are only two localities where the granite industry has been developed to a large extent. These are in the vicinity of Mt. Airy, Surry County, and in the vicinity of Faith, Rowan County, these two counties producing two-thirds of the total production of granite. The chief operator in Surry County is the North Carolina Granite Corporation, whose quarries are located about 1¼ miles northeast from the town of Mt. Airy, the county-seat. This is the most active quarry in the State. These quarries were first opened in 1889 by the Mt. Airy Granite Company, and since that date work has been continued steadily by this company, until the first of January, 1898, when they were leased to Thomas Woodroffe & Sons, who operated them continuously to July 1st, 1904, when the entire business was sold to the North Carolina Granite Corporation,

who are now actively engaged in developing and operating these quarries. The quarries are located in a 40-acre tract of nearly continuously exposed granite, which crosses over the slope and top of a long hill, which is 100 feet or more above the valley bottom, in which there is a railroad track that operates between the quarries and Mount Airy. The stone is handled from the quarries to the railway cars by a system of inclined cableways. The stone occurs in nearly solid masses and has been stripped over nearly all of the exposed area. The rock is of a very light gray, nearly white biotite granite of medium texture, containing no visible injurious minerals. The constituent minerals, feldspar, quartz, and biotite, are not evenly distributed through the mass of the granite, but there are some areas in which the rock is composed almost entirely of quartz and feldspar, making a rock of extreme whiteness. Where the rock is of uniform color, it forms an excellent and desirable stone for the purposes for which granite is used, except, perhaps, for monumental purposes. For this latter use there is hardly sufficient contrast of color between the cut and polished surfaces.

In operating the quarries, a suitable place, usually the brow of some small knoll, is selected, where a hole about 3 inches in diameter is drilled to the depth desired for making the sheet or raise of stone, which is usually from 5 to 7 feet in thickness. This hole is then charged with a quarter of a pound of dynamite which, upon exploding, pulverizes the stone slightly at the bottom of the hole and forms a small chamber. This hole is then cleaned out and recharged in the same way, using, however, instead of dynamite, black powder. This is kept up until a small seam has been started at the bottom of the hole, which extends parallel with the surface. The recharging with light charges of powder is then continued, increasing the charges gradually until the seam extends in all directions from the bottom of the hole and for a distance of 75 feet or more from the hole. The use of the explosive is then discontinued and a water-tight connection made to the hole by cutting off a piece of iron pipe of a suitable length and cementing it in the hole with melted sulphur. To this is attached an ordinary hand force-pump, and water is then pumped into the crevices which have been formed by the explosives. By means of continuous pumping of water into the crevices, this is extended until it covers an area sometimes as much as two acres in extent and finds vent by tearing out to the thin edges on the side of the hill. As stated

by Mr. Thomas Woodroffe, vice-president of the company, they experience no difficulty in raising sheets of stone in this manner covering from 1 to 2 acres, and from 6 to 8 feet in thickness close to the hill. After the pump is started to work it usually requires but a few hours of steady pumping to force the sheet out to the thin edge. He also states that it is necessary to clean off a ledge of stone made in this manner before attempting to form another sheet on the surface below, and that the best results are obtained in the hottest weather. The present company is making some very extensive improvements on the property, equipping it with a large stone-cutting plant, which will be supplied with the most modern stone-working appliances. The stone, which is used in considerable quantity as a building stone and also for curbing and paving blocks, is being shipped largely to Cincinnati, Philadelphia, Baltimore, Washington, and to numerous smaller places throughout Pennsylvania, Ohio, Maryland, Virginia, Tennessee and North Carolina. In a recent communication from Mr. Thomas Woodroffe, the shipments of stone per year from the Mount Airy quarries since July 3, 1890, when the first shipment of stone was made, are shown to be as follows:

ANNUAL SHIPMENTS OF STONE FROM MOUNT AIRY QUARRIES.

YEAR.	CARS.	YEAR.	CARS.
1890	135	1898	1,333
1891	204	1899	1,474
1892	334	1900	1,113
1893	523	1901	1,055
1894	952	1902	1,138
1895	834	1903	1,203
1896	548	1904	1,282
1897	1,044		

As is seen from the above table, the shipments of 1900 to 1904, inclusive, are less than the shipments for the years 1898 and 1899, but the net value of the product at the quarries was materially advanced in the latter years, this difference being accounted for by a larger volume of dressed stone having been handled where formerly there was a much greater quantity of rough stone.

The other locality, which has been the scene of the greater amount of the stone quarrying in the State, is in Rowan County, at Dunn's Mountain, which is located about 4 miles east of Salisbury, the

county-seat. The principal village in the vicinity is Faith. This mountain is a part of a conspicuous granite ridge some 12 to 14 miles in length. Its elevation is about 900 feet above sea-level and 150 feet above Salisbury. The granite of this ridge is of two distinct colors, one a very light gray to nearly white and the other a decided pink or flesh-colored stone. From Phillips Mountain, near the village of Faith in a southwestward direction, the granite of the ridge is of the very light gray to nearly white color, with none of the pink granite visible. Granite of a more or less pronounced pinkish color has been found over all parts of Dunn's Mountain proper, and this pink granite extends at intervals as far south as the village of Faith, where several openings have been made in it. Beyond this point, however, in a southwesterly direction, the granite is entirely of a light gray color. Between Dunn's Mountain proper and the village of Faith most of the rock is light gray, although there are a number of quarries that have been operated in the pink granite that is between these points.

There have been numerous quarries opened at this granite formation, of which the principal ones are the Dunn Mountain quarries (McCanless), the Rowan Granite Company's quarries, the Balfour Quarry Company's quarries, the Phillips Mountain quarries, and the Fowler's Mountain quarries. At the McCanless or Dunn's Mountain quarries the rock is uniformly light-gray granite of medium texture and of excellent working qualities. In places the granite assumes a pinkish-gray color, but this is not intense enough, as shown by the granite exposed at the present time, to warrant the quarrying for a pink granite.

The Rowan Granite Company's quarries are located within a few hundred yards of the Granite Quarry Station on the Salisbury and Norwood Branch of the Southern Railway. Some 12 to 15 openings have been made in different places over the 300-acre tract of land owned by this company, and the two largest openings will average about 200 feet long by 150 feet wide and have been worked to an average depth of 32 feet. From these quarries dimension stones weighing 70 to 100 tons each have been quarried. The color of the stone quarried is a light-gray granite, more or less speckled in places, with a pinkish tinge. The stone is used as a general building stone and also for curbing and paving blocks, and in smaller quantity for ornamental work and as ballast. It has been used in Washington and many of the larger places in Virginia and North Carolina.

The Balfour Quarry Company's quarries are located within less than half a mile south of the Rowan Granite Company's quarries, near Granite Quarry Station. The principal quarry of this company is in a beautiful pink granite. This granite is a very attractive stone, not only for general building, but also for monumental and decorative purposes. It is of a uniform color and texture and is susceptible of a very high polish.

About one mile southwest of the village of Faith is a very large, low, conical peak known as Phillips Mountain, which marks the southwest extension of Dunn's Mountain. The stone, as exposed in the quarries on this mountain, is of a very light-gray biotite granite of a uniform color and texture and is suitable for nearly all grades of work. There are a number of small openings that have been made on this mountain that have been worked to a more or less extent, although none have been developed into a quarry of any large size.

Three miles southwest of Faith is a low mass of granite which is known locally as Fowler's Mountain, which marks the southwest extension of the granite ridge. There has been but little work done in this mass of granite beyond several small openings that were made several years ago. The granite is light in color, composed largely of feldspar and quartz, and as far as could be observed, contains no injurious minerals.

The above two districts represent the largest granite-producing areas in the State, although there are a number of other districts in which granite of excellent quality is known to occur.

Production.

In 1904 the total value of all the granite produced was \$292,439, a decrease of \$41,918 as compared with the value, \$334,357, of the production of 1903. Considering the many granite localities throughout the State and the quality of the granite in these areas, this production does not begin to represent what the granite industry of the State should attain, for many of the quarries are well located for railroad transportation and the occurrences of the stone are such that they can be quarried very economically. The number of operators quarrying granite during 1904 was 14, who worked at 18 different localities in the following 10 counties, given in the order of the importance of their productions: Surry, Rowan, Rockingham, Buncombe, Polk, McDowell, Orange, Henderson, Vance, and Gaston.

The first three counties, in the order of the value of production in 1903, were Surry, Rowan, and Buncombe. Gaston County, with two operators, was lowest in the value of its production in 1904 and also in 1903. Approximately one-fourth of the granite produced in the State during 1904 was used for building and monumental purposes and amounted in value to \$75,632. This is a decrease of \$51,854 as compared with the value, \$127,486, of the granite used for the same purpose in 1903. There was a large increase in the value of the granite used for curbing and flagging, which in 1904 was valued at \$101,632, which, as compared with \$68,099, the value of the granite used for these purposes in 1903, is an increase of \$33,533. There is given in the table below the different purposes for which the granite quarried in the years 1901 to 1904 were used:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901-1904.

USES.	1901.	1902.	1903.	1904.
Building and monumental purposes.....	\$108,574	\$167,639	\$127,486	\$ 75,632
Paving blocks.....	10,662	6,986	30,780	15,807
Curbing and flagging.....	56,245	82,615	68,099	101,632
Crushed stone for road-making, railroad ballast, etc.	89,425	77,759	102,524	93,296
Other purposes.....	-----	3,750	5,468	6,072
Total value	264,906	338,749	334,357	292,439

SANDSTONE.

In North Carolina sandstone occurs as portions of triassic, carboniferous and silurian rocks, but the only ones that have been developed or worked in North Carolina are the triassic beds. The color of these sandstones varies somewhat throughout the belt, but they are principally of red-brown hue. One drawback to the development of the sandstone beds of the State has been the abundant jointing that has developed in the beds, which causes the stone in many of the deposits to break into blocks of rather small size.

The principal deposits are located in Anson, Moore, Chatham, Wake, and Durham counties. In some of these counties no systematic quarrying has been done for a great many years, and in others but little work has been done, which has simply been to supply a local demand for this stone. In Anson County the principal quarrying has been done at the old Linehan quarry, on the Jessie Edwards estate,

1 $\frac{1}{4}$ miles northwest of Wadesboro; at the Wadesboro Brownstone Company's quarry, about 1 $\frac{1}{2}$ miles northwest of Wadesboro. This quarry furnished what is known as the "Wadesboro brownstone," which for a number of years was used quite extensively as a building stone. In Moore County the principal quarrying has been in the vicinity of Carthage, and some of the most promising sandstone deposits in the State have been found here. There have also been some good quarries developed in the vicinity of Sanford, of which the principal one is the Carrington & Gonella quarry. There are no quarries at the present time in operation in Chatham County, although some promising outcrops of sandstone have been located on the banks of Deep River and also at Haw River. The development of any quarries on Deep River would be favorably located for transportation, as the river could be used for transporting the stone by means of barges to railroad centers.

Production.

In 1904 the production of sandstone had decreased to a value of \$250 and the stone was obtained from Anson County. In 1903 there was only a production that amounted to \$600 in value. In the table below is given the value of the production of sandstone for the years 1901 to 1904:

PRODUCTION OF SANDSTONE IN NORTH
CAROLINA. 1901-1904.

YEAR.	VALUE.
1901	\$11,682
1902	4,825
1903	600
1904	250

MARBLE AND OTHER FORMS OF LIMESTONE.

Limestones, either as the compact variety or as marble, are not very abundant rocks in North Carolina and have been observed in the southeastern counties of New Hanover and Craven as coarsely cavernous shale limestones and more compact limestones which can and have been used locally for rough construction work and for road-building. A semi-crystalline limestone occurs in Catawba, Lincoln, and Gaston counties, and marbles in McDowell, Cherokee, and Swain counties.

small areas of limestone also occur in Madison, Buncombe, and Henderson counties.

The above deposits have been mentioned and described in previous reports, and full descriptions of the localities and occurrences are given in the report on Building Stones, which is now in press.

Recently a new deposit of marble has been discovered in the State, which is exposed in a cut on the South and Western Railway, near the mouth of Sink Hole Creek on the north bank of North Toe River, about $3\frac{1}{2}$ miles above Toe Cane Station. The marble is pure white in color and rather coarsely crystalline. Its texture is uniform and is exceptionally pure and homogeneous throughout. The bed has an average thickness of about 60 feet.

A similar outcrop of marble has been found on the land of Mr. W. F. Jackson, on the north side of Sink Hole Creek. The location of the deposit is favorable for quarrying, as it is on a mountain-side hundred feet above the valley, thus affording good dumping ground for waste material and can also be naturally drained.

The marbles of Cherokee County have continued to be worked during 1904 by the National Marble Company, at their quarry, and the stone that they have taken out and put on the market has found a ready sale for monumental and also for building purposes.

A new limestone quarry has recently been opened in Buncombe County, about 2 miles from Fletcher, a station on the Southern Railway. It is on the same limestone strata as the old Lance property, it is 600 or 700 feet distant from this old quarry and on what is known as the Westfeldt property. The property is operated by the Blue Ridge Lime Company, which was incorporated under the laws of North Carolina in 1904. The quarry and kilns are connected by a roadway with the railroad at Fletcher. The company has erected 70 modern kilns, which have a capacity of 700 bushels per day.

This rock is of a peculiar fine-grained structure with a very smooth touch. An analysis of this stone by Mr. D. K. Pope, of the United States Assay Office at Charlotte, gave the following results:

ANALYSES OF LIMESTONE FROM FLETCHER, NORTH CAROLINA.

MINERAL.	I.	II.
	<i>Per Cent.</i>	<i>Per Cent.</i>
Silica	1.40	1.70
Alumina and ferric oxide.....	.58	.58
Lime	53.32	53.38
Magnesia	1.62	1.32
Carbonic acid.....	43.66	43.39
Total.....	100.58	100.37

There are little or no impurities in the limestone, and the calcium carbonate constitutes 95.32 per cent. of the rock. A test was made also by Mr. Pope of this limestone by burning Sample I at a strong red heat for two hours, at the end of which time 95.74 per cent. of the theoretical amount of lime was obtained. The stone burned easily and made a pure white lime. In Sample II, which was heated for two hours at a strong red heat, there was 90.3 per cent. of the stone converted into lime, which was also a very white lime and gave no difficulty in burning. Another hour's heating would have converted practically all of the rock into lime.

There is a large demand for lime in North Carolina, which at the present time is being supplied largely from Tennessee and Virginia, and the development of any limestone deposits in the State for the purposes of manufacturing lime are of a decided value to the State.

Production.

The total production of marble and other forms of limestone in North Carolina during 1904 was valued at \$19,887, which is a decrease of \$5,478 as compared with the production of 1903, which was valued at \$25,365. The larger proportion of this production was used for road building and curbing. The production was obtained from New Hanover, Buncombe, Cherokee, and Henderson counties, given in the order of the importance of their productions. All the production from Henderson and Buncombe counties was used in the manufacture of lime. In the following table is given the value of the production of limestone from 1901 to 1904:

PRODUCTION OF MARBLE AND OTHER
FORMS OF LIMESTONE, 1901-1904.

YEAR.	VALUE.
1901	\$ 8,357
1902	23,153
1903	25,365
1904	19,887

SLATE.

There was no production of slate in North Carolina during 1904.

DECORATIVE STONES.

There are a number of stone deposits throughout the State of various kinds which are capable of being developed into decorative stones which should have some considerable commercial value and demand. The principal deposits are the pink granite in the vicinity of Dunn's Mountain, near the village of Faith, Rowan County, which has been described above; and an orbicular diorite which occurs 10 miles west of Lexington and one mile west of Oaks Ferry, on the Yadkin River. This rock is of a dark color with a greenish tinge, which is produced by nodules of a dark-green hornblende which are lying close together and often touching each other, while the intervening areas are filled with a clear, white, lustrous feldspar. A considerable portion of this diorite is distinctly orbicular, while other portions are more granitic. This rock dresses well under the hammer, takes a high polish, and is acted upon little, if any, by weathering, as is indicated by stone steps, posts, etc., made of this stone that have been used at the Hairston residence for over 50 years.

Another decorative stone is serpentine, which occurs quite prominently in a number of localities in North Carolina, principally in Madison, Wilkes, and Wake counties. The most favorable localities are between Weaverville and Leicester, Buncombe County, and a strip that crosses the French Broad River a mile above Alexander, and on the property of Mr. W. L. Foster, $2\frac{1}{2}$ miles from Olivet, a station on the Southern Railway, and on land of W. E. Pounder, a short distance further southwest; near North Wilkesboro, Wilkes County, where the serpentine that has been obtained is of good color, hard, compact, and susceptible of a high polish, and is within $\frac{3}{4}$ of a

mile of the railway; and in Wake County, on Barton Creek, about 14 miles northwest of Raleigh, on land belonging to Dr. A. J. J. Penny, Mr. Jesse Adams, and Mr. Joseph Tadlock.

CLAY.

The clay deposits of North Carolina continue to attract considerable attention, and there is a constant demand for kaolin or china clays, which is at the present time greater than can be supplied. The various phases of the clay industry in North Carolina offer very flattering opportunities for investment. When it is taken into consideration that there are in the State suitable clays for the manufacture of all kinds of earthenware, sewer-pipe, terra-cotta, porcelain-ware, decorative brick, fancy and pressed brick, it is with surprise that one, on investigation, learns that the larger part of these materials that are consumed in North Carolina are imported from outside the State. This is especially true of decorative and pressed brick, and in the many buildings throughout the State the bricks of this type which have been used in their construction have been imported. Although there has been an advance in the quantity and value of the brick produced in North Carolina each year for the past three or four years, yet there has been but little improvement in the quality of the brick manufactured and the manufacturers have not made any serious attempt to introduce any new methods or modern machinery in the manufacture of their brick. Thus, the average quality of the brick has been improved but little. The average value of the 143,988,000 brick manufactured in North Carolina during 1904 was \$5.45 per thousand, which is an increase of 9 cents per thousand. While this average value of the common brick is all that they were probably worth, yet by exercising a little more care and with improved machinery, the quality of brick could be largely improved with but very little additional expense and would command a considerably higher average price per thousand. One reason for this low average value per thousand of these common brick is that too many have undertaken the manufacture of brick of this sort without knowing very much regarding the clay industry, or methods of manufacture of brick, or how to make a good quality of common brick. They are inexperienced in mixing the ingredients of the brick, in molding, stacking, and burning the brick.

The field for investment in the manufacture of pressed, fancy and vitrified brick is also large, as can be realized when it is known that out of the many millions of brick of this type that are used in North Carolina less than two million are manufactured within the State.

Another phase of the clay industry that should be very largely increased is the manufacture of earthenware, stoneware and decorative ware. At the present time this is but a very small industry in the State, while it is capable of becoming one of considerable magnitude, as the clays are in quantity and of the right quality for the manufacture of this type of clay products and there is a considerable demand for them in the State, as is evidenced by the quantity of these products that are being imported each year. These questions will be discussed more in detail under the subjects of the different clay products.

KAOLIN OR CHINA CLAY.

The principal changes in the kaolin industry of North Carolina since the publication of the last report are the production of kaolin from the deposit near Bostick's Mills, 4 miles north of Rockingham, Richmond County, and the development of the deposit of kaolin in Swain County on the headwaters of Panther Creek, near Almond. The principal supply of kaolin is still from the Harris mine, near Webster, Jackson County. There are other promising deposits of this clay near West Mills and Liberty Church, Macon County, and these deposits should soon have railroad transportation facilities, as the railroad from Tallulah Falls, Georgia, to Franklin, Macon County, has now reached the State line and is being pushed down the Little Tennessee Valley toward Franklin. Still other deposits that are worthy of investigation are 4 miles west of Troy, Montgomery County; near North Wilkesboro, Wilkes County; and in Beaver Dam Township, 2 miles southwest of Canton, Haywood County.

At the present time nearly all of the kaolin that is mined in the State is shipped to potteries at Trenton, N. J., or East Liverpool, Ohio, where it is used in the manufacture of tiling, for the better grades of porcelain and for the enamelling of brick. An extensive line of samples of these products made with North Carolina kaolin, principally from the Harris mine, Jackson County, was exhibited at the World's Fair, St. Louis, during 1904, and are now in a collection in the State Museum at Raleigh. All these materials and others,

such as electric porcelain insulators, etc., which are now imported into the State, should be largely manufactured within the State from North Carolina kaolin and other pottery clay. This side of the clay industry should make a profitable investment, but it requires skilled workmen to undertake this work.

Production.

The production of kaolin in North Carolina during 1904 was from Jackson and Richmond counties, the total quantity mined being 9,110 tons, valued at \$76,670. This is an increase of 505 tons in quantity and of \$670 in value as compared with the production in 1903 of 8,605 tons, valued at \$76,000. This, however, was a decrease of 4,202 tons in quantity and of \$31,435 in value as compared with the production in 1902 of 13,322 tons, valued at \$108,105. The average value per ton of the 1904 production was \$8.41, which is a decrease of 42 cents as compared with the average value of \$8.83 per ton of the 1903 production. This, however, is an increase of 30 cents per ton as compared with the average value of \$8.11 per ton of the 1902 production.

There should be in 1905 a decided increase in the production of kaolin, due to the development of the Swain County deposits, which are being operated by the F. R. Hewitt Kaolin Company, of Almond, N. C., and also by the further development of the Richmond County deposits by the Richmond Mining Company, of Bostick's Mills.

POTTERY CLAY.

There has been little or no increase in the development of the pottery industry in North Carolina for the past 10 years, and during the past 4 years there has been a steady decline in the value of the manufacture of the line of clay products. There is no well-developed pottery industry in the State, and the small production is divided amongst 27 producers, the lowest value reported being \$60 and the highest \$2,465. The value of the production of most of these manufacturers is from \$300 to \$600, there being but three who made a production valued at over \$1,000. A large part of this earthen and stoneware is crude and but little has been done to utilize any improved methods or to push this industry. There are plenty of clays in North Carolina suitable for making earthen and stoneware, which

are the finer alumina sediments underlying the river terraces found in many of the broader valleys, the better clays being found usually near the shore line of the terrace. Such clays are found underlying the terraces along the Catawba River north of Morganton and Mt. Holly, Burke County, and near Blackburn and Catawba, Catawba County; the South Fork of the Catawba River, just north of Lincolnton, Lincoln County; the Yadkin River, near Wilkesboro, Wilkes County; and Elkin, Surry County; including the old terraces of the Deep River, near Ulah and Whynot, Randolph County. In the eastern part of the State, along the Cape Fear River, near Fayetteville, Cumberland County; the Neuse River, near Goldsboro, Wayne County; and Contentnea River, a tributary of the Neuse, in Wilson County, near Wilson, are similar deposits of clay.

Production.

The value of the production of pottery in North Carolina during 1904 was \$13,900, which is a decrease of \$412 as compared with \$14,312, the value of the production of 1903. The number of pottery manufacturers engaged in making this production was 27, who were located in the following 9 counties, given in the order of the importance of their productions: Catawba, Lincoln, Buncombe, Wilkes, Randolph, Chatham, Union, Johnston, and Montgomery. In 1903 there were but 23 pottery manufacturers, who were located in the same counties as above, with the exception of Montgomery, which did not report in 1903 any production of pottery. Of the 1904 production, \$438 was the value of the red earthenware and \$13,462 the value of the stoneware. There were a few dollars of decorative ware reported, which is included under red earthenware.

There is a constant demand for this red earthenware and stoneware, and the pottery manufacturers should, with improved methods and by using better material for glazing the ware, be able to put a uniform and high-grade pottery on the market with but little additional expense, which would create a much larger demand for their products. For the development of this industry capital is needed as well as experienced men.

There was a small amount of pottery clay that was sold crude in 1904, amounting to 142 tons, valued at \$61.

The values of the different grades of pottery produced during 1903 and 1904 are given by counties in the following table:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA
BY COUNTIES IN 1903 AND 1904.

COUNTY.	1903.			1904.		
	EARTHEN-WARE.	STONE-WARE.	TOTAL.	EARTHEN-WARE.	STONE-WARE.	TOTAL.
Buncombe	\$ 60	\$ 2, 200	\$ 2, 260	\$ 31	\$ 1, 300	\$ 1, 331
Catawba		3, 155	3, 155		4, 450	4, 450
Chatham		2, 000	2, 000		600	600
Johnston	80	225	335	50	350	400
Lincoln	100	3, 270	3, 370	15	3, 970	3, 985
Montgomery				50	300	350
Randolph	222	1, 320	1, 542	150	1, 040	1, 190
Union	100	400	500	100	300	400
Wilkes	50	1, 100	1, 150	42	1, 152	1, 194
Total	612	13, 700	14, 312	438	13, 462	13, 900

FIRE-CLAY AND PIPE-CLAY.

There are a few localities in North Carolina which contain deposits of fire-clay, the more prominent ones being at Pomona, Guilford County; Grover, Cleveland County; Emma, Buncombe County; and near Archdale, Randolph County. There is but little work being done at any of these fire-clay deposits, and during 1904 it was confined to the deposits in Buncombe and Randolph counties. A part of the clay produced was sold in the crude state and the rest manufactured into fire-brick.

The pipe-clay deposits are more numerous than those of the fire-clay, and those worked in 1904 were in Guilford, Forsyth, Randolph, and Beaufort counties.

Production.

The total value of all fire-clay and pipe-clay production reported in 1904 was \$114,200, this including fire-brick, fire-clay sold crude, sewer-pipe, tile, terra-cotta, etc. This is an increase of \$7,086 in value as compared with \$107,114, the value of the production of 1903. This in turn was an increase of \$33,078 in value as compared with the value of the production of 1902, which was \$74,036. This branch of the clay industry has been increasing rapidly during the

past four or five years and illustrates what can be accomplished in the manufacture of the better grade of clay products. This, however, has been due principally to the progressiveness of the Pomona Terra-cotta Company at Pomona, Guilford County. This company's products are being shipped all over the State and to adjoining States.

Of this 1904 production, \$2,700 was the value of 163,000 fire-brick, which were manufactured in Buncombe and Randolph counties. As compared with the manufacture of fire-brick in 1903, which numbered 407,500 brick, valued at \$5,250, this is a decrease of 244,500 fire-brick in quantity and of \$2,550 in value. There was a small amount of crude fire-clay sold in 1903, amounting to 80 tons, valued at \$700.

The production of sewer-pipe, tile, terra-cotta, etc., during 1904, was from Guilford, Forsyth, Randolph, and Beaufort counties, and was valued at \$110,800, as compared with a production valued at \$100,989 in 1903. This is an increase in value of \$9,811. Although there has been this continued increase from year to year in the value of the production of pipe-clay products, still the production does not begin to represent what this phase of the clay industry should amount to in North Carolina.

The following table, which gives the production of pipe-clay products for the past four years, shows the decided increase from year to year in the production of these products:

PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN
NORTH CAROLINA, 1901-1904.

YEAR.	FIRE-BRICK.		SEWER-PIPE, TILE, ETC.	CRUDE CLAY.	
	QUANTITY.	VALUE.		TONS.	VALUE.
1901	55,000	\$ 550	\$ 55,745	-----	\$ 100
1902	-----	1,203	72,618	-----	215
1903	407,500	5,250	100,989	231	875
1904	163,000	2,700	110,800	80	700

BRICK CLAY.

There are but few counties throughout North Carolina but contain clay deposits that are suitable for the manufacture of common brick, consisting of both residual and sedimentary clays. In a number of

counties the clay is of such quality that it is capable of being used in the manufacture of pressed brick, front brick, or decorative brick. In order, however, to increase the manufacture of brick in the State and to make it a more profitable industry, it is absolutely essential that more attention be given to details in the manufacture of the brick (especially common brick), in order that a better and more homogeneous brick can be put on the market and one that is not only more attractive in appearance, but also capable of standing transportation and rough handling. Although there has been a decided increase from year to year during the past four years in the quantity and value of brick produced in the State, still this increase is not followed as rapidly as is warranted by the extensive building operations that have been going on throughout the State, and is due to the fact that in many of the buildings throughout the State a better quality of brick is desired and used than is produced in the State, and is consequently imported. The quality of the common brick produced in many of the counties is very inferior, but it is not the fault, in many cases, of the clay, but to the method of manufacture and incompetent employees. There has been but little attention paid to the manufacture of pressed, front, or fancy brick, although there are clays in the various parts of the State that are adapted to the manufacture of such brick, as those near Asheville, Buncombe County; Wilkesboro, Wilkes County; Goldsboro, Wayne County, etc. Many of these places are at the intersection of several lines of railroads, so that there would be good railroad facilities for shipment of the manufactured products. There have been used during the past year many million fancy, front, and pressed brick in North Carolina, of which less than 2,000,000 were manufactured in the State. It is almost impossible to obtain a first-class pressed brick in North Carolina, and when desired for use they have to be imported from South Carolina, Virginia, Maryland, and from other States.

One obstacle that has prevented the building up of the brick industry in the State is that the larger number of those engaged in this industry have little or no capital, so that they cannot install improved machinery, or take advantage of improved methods, and are compelled to employ incompetent laborers, with the result that the brick they put on the market is of a decidedly inferior quality. They are not able to burn more than one kiln at a time, and have to wait until this has been sold, or at least partly sold, before they are able to begin on

other. The result is that during some parts of the year there is an excessive supply of brick on the market at a low figure and at other times during the year, especially in the late winter, there is scarcity of brick, and the price, even for the inferior grades, runs up to \$8 to \$10 a thousand. The manufacture of brick in North Carolina does not offer safe and profitable investments, with a large and ready market for the manufactured good and at a good profit.

Production.

The total number of brick, with the exception of fire-brick, manufactured in North Carolina during 1904 amounted to 145,928,850, valued at \$816,719. As compared with the production of 138,088,000 brick, valued at \$745,032, in 1903, this is an increase of 7,839,850 brick in quantity and of \$71,687 in value. The average value per thousand of the 1904 production of brick was \$5.54, as compared with \$5.39, the average value per thousand of the 1903 production, is being an increase of 15 cents per thousand. There were 57 counties from which this production was obtained, which is 5 less than in 1903, which in turn was 5 less than in 1902. Six counties—Curritton, Ashe, Jackson, Martin, Sampson, and Stanly—which reported production of brick during 1903, reported none in 1904; while Johnston County, which made no production in 1903, became a producer in 1904. Of the 1904 production, there were 143,988,850 common brick, valued at \$795,494, which is an increase of 7,165,950 brick in quantity and of \$63,692 in value as compared with 136,822,000 common brick, valued at \$731,802, the production of 1903. The number of pressed brick manufactured in 1904 was 1,510,000, valued at \$17,375, and of vitrified brick 430,000, valued at \$3,850, as compared with the production of 766,000 pressed brick, valued at \$10,230, and 500,000 vitrified brick, valued at \$5,000, in 1903. In the table below are given the quantity and value of common, pressed, vitrified and fire-brick produced in 1902, 1903, 1904:

**PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND
FIRE-BRICK IN 1902, 1903 AND 1904.**

Character.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Common brick-----	131,618,700	\$ 694,827	136,822,900	\$ 731,802	143,988,850	\$ 796,494
Pressed brick-----	1,833,000	10,625	766,000	8,230	1,510,000	17,375
Vitrified brick-----	600,000	6,000	500,000	5,000	430,000	3,850
Fire-brick-----	120,000	1,203	407,500	5,250	163,000	2,700
Total-----	134,171,700	712,655	138,496,400	750,282	146,091,850	819,419

The average value per thousand received for common brick in 1904 was \$5.45, which is 11 cents greater than the average value of \$5.34 per thousand of the 1903 production. The lowest value per thousand reported as having been received for common brick during 1904 was \$2.25, which was received for 30,000 brick manufactured in Randolph County, and the highest value per thousand was \$8.00, which was received for 100,000 brick from Beaufort, 300,000 from Washington, and 1,000 from Chatham counties. As a general rule, the brick manufactured in the extreme eastern counties bring a relatively higher average value than those manufactured in the other sections of the State, on account of the higher cost of the brick imported into these counties. The number of manufacturers engaged in making brick in 1904 was 179, which is 8 more than the number (171) engaged in this business in 1903, which was 24 less than the number (195) in 1902.

Although the number of manufacturers of brick was less in 1904 than in 1903, and the number of counties producing brick was less, yet the quantity and value of the production were greater, showing a relatively larger production from many of the producers in the State. There are some very extensive plants that are manufacturing a good quality of brick, using improved methods, etc., such establishments being located in the vicinity of Goldsboro, Wayne County; Greensboro, Guilford County; Charlotte, Mecklenburg County; Winston-Salem, Forsyth County; Wilmington, New Hanover County, etc.

There is given in the following tables the total number and value of the different varieties of brick, including fire-brick, manufactured in North Carolina during 1903 and 1904 by counties:

AMOUNT AND VALUE OF BRICK MADE IN NORTH CAROLINA
DURING 1904, BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRI- FIED AND FIRE- BRICK.	VALUE.
	4,440,000	\$ 25,750		\$		
	2,840,000	17,000			30,000*	300
	1,475,000	8,850				
	300,000	1,800				
	3,575,000	18,860	100,000	1,250	153,000†	2,600
	550,000	2,800				
	5,350,000	26,750	100,000	1,000		
	2,200,000	8,800				
	841,000	1,850				
	1,960,000	10,045				
	151,000	708				
	1,000,000	7,000				
	915,000	4,800				
	2,000,000	10,300				
	8,639,000	47,515				
d	1,750,000	9,500				
	1,075,000	5,300	5,000	75		
	26,000	174				
	3,665,000	19,625				
	6,075,000	36,200				
	5,320,000	28,540				
	3,500,000	19,400				
	90,000	270				
	60,000	420				
	13,450,000	78,368	50,000	500	100,000*	850
	4,100,000	24,000	125,000	1,250		
	250,000	1,450				
	800,000	4,400				
	2,000,000	10,000	30,000	300	300,000*	2,700
	995,000	5,250				
	2,840,000	15,800				
	500,000	2,000				
	1,225,000	6,300				
	450,000	2,700	200,000	2,000		
	150,000	750				
rg	3,500,000	21,000				
ry-	10,000	40				
	2,800,000	16,400				
	1,300,000	7,800				
ver	2,750,000	17,125	800,000	10,000		
	1,217,000	6,628				
k	1,900,000	10,800				
	2,200,000	13,200				
	990,000	5,266			10,000†	100
	1,805,000	10,788				
m-	7,680,000	38,075	100,000	1,000		
j	4,100,000	23,000				
	1,000,000	5,700				
	500,000	3,000				
ia-	1,325,000	6,375				
	125,000	750				
	4,879,000	24,768				
	5,717,850	31,479				
m	300,000	2,400				
	9,000,000	49,625				
	1,500,000	7,500				
	5,273,000	30,500				
	143,988,850	795,494	1,510,000	17,375	593,000	6,550

red brick.
brick.

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA
DURING 1903 BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRI- FIED AND FIRE- BRICK.	VALUE.
Alamance	2,750,000	\$ 15,250		\$		\$
Anson	1,000,000	5,500				
Ashe	300,000	1,500				
Beaufort	1,323,000	8,200				
Bertie	4,600,000	21,000				
Bladen	200,000	1,100				
Buncombe	4,305,900	22,686	150,000	2,250	365,500*	5,100
Burke	400,000	1,600				
Cabarrus	5,010,000	25,055	100,000	1,000		
Caldwell	1,500,000	5,250				
Carteret	150,000	900				
Catawba	1,920,000	9,680				
Chatham					2,000†	20
Chowan	1,000,000	7,000				
Cleveland	975,000	5,320	200,000	2,000		
Columbus	2,000,000	10,000				
Craven	6,000,000	47,750				
Cumberland	1,750,000	9,500				
Davidson	500,000	2,500				
Duplin	50,000	278				
Durham	6,710,000	36,210				
Edgecombe	5,450,000	32,700				
Forsyth	8,505,000	44,625	150,000	1,500		
Gaston	2,670,000	14,350				
Gates	105,000	375				
Greene	635,000	4,445				
Guilford	8,188,000	44,817				
Halifax	3,400,000	19,500	70,000	600		
Harnett	2,500,000	10,800				
Haywood	700,000	3,990				
Henderson	1,000,000	5,000			500,000*	5,000
Iredell	3,200,000	15,900				
Jackson	70,000	420				
Johnston	1,730,000	10,350				
Lenoir	1,000,000	6,500				
Lincoln	830,000	4,150				
McDowell	2,900,000	14,500				
Martin	8,000	48				
Mecklenburg	2,300,000	14,000				
Montgomery	282,000	1,403				
Moore	2,682,000	13,687				
Nash	1,000,000	5,500				
New Hanover	2,750,000	16,500				
Orange	1,000,000	4,950			30,000†	30
Pasquotank	1,800,000	10,800				
Pitt	1,240,000	7,458				
Randolph	780,000	3,742			10,000†	100
Robeson	352,000	2,103	14,000	124		
Rockingham	3,216,000	18,860				
Rowan	2,500,000	13,500				
Rutherford	650,000	3,340				
Sampson	50,000	250				
Scotland	600,000	3,300				
Stanly	300,000	1,200				
Surry	1,210,000	5,765	50,000	500		
Transylvania	95,000	500				
Union	3,437,000	15,555				
Wake	5,166,000	26,095				
Washington	30,000	240				
Wayne	9,150,000	51,075				
Wilkes	1,598,000	7,990	32,000	256		
Wilson	6,300,000	35,250				
Total	136,822,900	731,802	766,000	8,230	907,500	10,250

*Vitrified brick.

†Fire-brick.

Of the 97 counties in North Carolina, only 57 reported any production of brick. The County producing the largest number of brick in 1904 was Guilford, whose production was 13,450,000, valued at \$78,368. Wayne was second with a production of 9,000,000, valued at \$49,625, and Rockingham third with a production of 7,580,000, valued at \$38,075. In 1903 Wayne County was first in its production of brick, Forsyth County second, and Guilford County third, with the following productions respectively: 9,150,000, valued at \$51,075; 8,655,000, valued at \$46,125; and 8,188,000, valued at \$44,817. The county producing the smallest number of brick was Montgomery, which reported a production of only 10,000 brick, valued at \$40. In 1903 Martin County was the smallest producer, with 10,000 brick, valued at \$48.

There is given in the table below the quantity and value of all the clay products produced in North Carolina in 1901, 1902, 1903, and 1904:

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN
1901, 1902, 1903, AND 1904.

	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
on brick ---	134,441,570	\$ 697,861	131,611,700	\$ 694,827	136,822,900	\$ 731,802	143,988,850	\$ 796,494
d brick ---	1,095,000	10,220	1,233,000	10,625	766,000	8,230	1,510,000	17,375
ed brick ---	180,000	1,650	600,000	6,000	500,000	5,000	430,000	3,850
rick ---	55,000	550	---	1,203	407,500	5,250	163,000	2,700
nware ---	---	4,490	---	658	---	612	---	438
ware ---	---	17,453	---	13,854	---	13,700	---	13,462
ited ware ---	---	552	---	---	---	---	---	---
-pipe, tile, ---	---	55,745	---	72,618	---	100,989	---	110,800
	Tons.		Tons.		Tons.		Tons.	
-----	15,575	119,172	13,322	108,105	8,605	76,000	9,110	76,670
lay -----	---	100	---	215	231	875	202*	761
tal value ---	---	907,793	---	908,105	---	942,458	---	1,021,550

*Including ordinary stoneware clay sold rough.

The above statistics regarding the clay production of the State do not, perhaps, represent the output in its entirety for the reason that many of the counties there are a few thousand brick occasionally made for local purposes regarding which it is difficult or impossible to obtain any statistics, this being especially true where the bricks are not for sale, but are used directly by those making them.

In the following table there is given the values of the various minerals produced in North Carolina for the years 1900 to 1904, inclu-

sive, and shows at a glance the variations in the production of the different minerals, and also shows up concisely those minerals which have made a constant increase in their productions since 1900 :

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE
YEARS 1900, 1901, 1902, 1903, AND 1904.

MINERAL.	VALUE.				
	1900.	1901.	1902.	1903.	1904.
Gold	\$ 46,653	\$ 60,411	\$ 93,650	\$ 113,604	\$ 123,924
Silver	15,986	34,024	30,212	16,907	19,132
Copper	41,600	76,900	212,553	67,037	36,600
Iron	42,000	4,997	52,771	78,540	79,846
Pyrite	14,625	32,000			
Garnet	18,000	43,000	10,040	} 12,250	6,586
Corundum	36,840	48,840			
Millstones			1,425	902	6,500
Mica { Sheet	65,200	79,849	81,653	86,300	100,724
{ Scrap	36,262	14,200	2,919	2,400	3,410
Quartz		7,500	11,250	36,827	36,269
Precious stones	12,020	24,245	5,300	1,525	10,600
Rare minerals			60	270	160
Monazite	48,805	59,262	64,160	58,694	79,438
Zircon			360	570	200
Barytes		22,615	44,130	21,347	33,930
Talc and pyrophyllite	42,000	77,974	88,962	76,984	65,483
Graphite		559	4,300	248	525
Coal	22,500	5,585	24,500	25,300	8,820
Stone	285,172	284,744	366,727	360,322	312,576
Kaolin	62,440	119,172	108,105	76,000	76,670
Clay products	815,975	788,618	800,000	866,458	944,880
Total value	1,604,078	1,779,109	2,003,077	1,902,485	1,946,273

As is seen from the above table, the total value of \$1,946,273 is somewhat greater than the total value of \$1,902,485 of the 1903 production, this increase amounting to \$43,788. This production was obtained from 76 counties out of the 97 in the State, and in the following table the value of the production for the years 1903 and 1904 in each county is given. The value of the clay products, with the exception of kaolin, which is included with "other minerals," is given separately from the rest of the mineral production.

**VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH
CAROLINA IN 1903 AND 1904.**

COUNTY.	1903.			1904.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Adair	\$ 50	\$ 15,250	\$ 15,250	\$ 150	\$25,750	\$ 25,774
Albemarle	600	5,500	6,100	304		304
Ashe	1,000	1,500	2,500	175		175
Beaufort		8,200	8,200		17,500	17,500
Bertie		21,300	21,300		8,850	8,850
Bladen		1,100	1,100		1,800	1,800
Boone	14,566	32,371	46,937	24,728	23,471	48,199
Burke	12,629	1,600	14,229	26,806	2,800	29,606
Cabarrus	3,323	26,055	29,378	15,083	27,750	42,833
Caldwell	42	5,250	5,292	10,047	8,800	18,847
Catawba		900	900		1,850	1,850
Chatham	7,060	12,835	19,895	5,544	14,520	20,064
Cherokee	27,523	2,000	29,523	8,918	1,308	10,226
Chowan	50,116		50,116	45,211		45,211
Citrus		7,020	7,020		7,000	7,000
Cleveland	297		297	2,458		2,458
Columbus	19,969	7,320	27,289	32,682	4,800	37,482
Curry		10,000	10,000		10,300	10,300
Dalhart		47,750	47,750		47,515	47,515
Dare		9,500	9,500		9,500	9,500
Davidson	672	2,500	3,172	1,694	5,375	7,069
DeWitt		278	278		174	174
Dobson		36,210	36,210		19,625	19,625
Durham		32,700	32,700		36,200	36,200
Edgecombe		46,401	46,401		28,840	28,840
Fayette	165		165	90		90
Franklin	1,112	14,350	15,462	1,111	19,400	20,511
Gaston		375	375		270	270
Gibson	5,477		5,477	1,799		1,799
Granville		4,445	4,445		420	420
Greene	3,966	144,817	148,783	12,899	189,718	202,617
Guilford	426	20,100	20,526	180	25,250	25,430
Hamilton		10,800	10,800		1,450	1,450
Henderson	18,560	3,990	22,550	36,500	4,400	40,900
Hertford	17,589	10,800	28,389	11,295	13,000	24,295
High	160	15,900	16,060	240	5,250	5,490
Holden	94,646	420	95,066	76,854		76,854
Johnston	15,000	10,685	25,685		16,150	16,150

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH
CAROLINA IN 1903 AND 1904—Continued.

COUNTY.	1903.			1904.		
	MINERAL PRO- DUCTION, INCLUD- ING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRO- DUCTION, INCLUD- ING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Lenoir	\$	\$ 6,500	\$ 6,500	\$	\$ 2,000	\$ 2,000
Lincoln	15,256	7,520	22,776	1,841	10,270	12,111
McDowell	34,680	14,500	49,180	27,190	4,700	31,890
Macon	3,749		3,749	47	750	797
Madison	26,447		26,447	37,986		37,986
Martin		48	48			
Mecklenburg	8,682	14,000	22,682	1,183	21,000	22,183
Mitchell	93,127		93,127	109,466		109,466
Montgomery	49,513	1,403	50,916	51,362	390	51,752
Moore	7,769	13,687	21,456	5,860	16,400	22,260
Nash	142	5,500	5,642	45	7,800	7,845
New Hanover	20,400	16,500	36,900	12,346	27,125	39,471
Northampton						
Onslow						
Orange	27,781	4,980	32,761	10,617	6,628	17,245
Pamlico						
Pasquotank		10,800	10,800		10,800	10,800
Pender	600		600			
Perquimans						
Person	71,316		71,316	15,506		15,506
Pitt		7,458	7,458		13,200	13,200
Polk	7,507		7,507	13,733		13,733
Randolph	403	5,797	6,200	26,236	6,481	32,717
Richmond				770		770
Robeson		2,227	2,227		10,788	10,788
Rockingham	10,200	18,860	29,060		39,075	39,075
Rowan	112,573	13,500	125,073	127,774	23,000	150,774
Rutherford	12,344	3,340	15,680	5,904	5,700	11,604
Sampson		250	250			
Scotland		3,300	3,300		3,000	3,000
Stanly	24,640	1,200	25,840	17,271		17,271
Stokes	7,740		7,740			
Surry	111,462	6,255	117,717	110,466	6,375	116,841
Swain	53,150		53,150	57,258		57,258
Transylvania	516	500	1,016		750	750
Tyrrell						
Union	3,198	16,055	19,253	9,902	25,168	35,070
Vance	14,750		14,750	8,000		8,000
Wake	248	26,095	26,343	525	31,479	32,004
Warren	751		751	361		361
Washington		240	240		2,400	2,400
Watauga						
Wayne		51,075	51,075		49,625	49,625
Wilkes		9,396	9,396		8,694	8,694
Wilson		35,250	35,250		30,500	30,500
Yadkin						
Yancey	20,600		20,600	35,300		35,300
Unknown	1,525		1,525	1,047		1,047
Total value	866,458	1,036,027	1,902,485	1,001,393	944,880	1,946,273

As is seen from the above table, the following counties reported no production of mineral of any kind during 1904: Alleghany, Brunswick, Camden, Caswell, Currituck, Dare, Davie, Graham, Hertford, Hyde, Jones, Martin, Northampton, Onslow, Pamlico, Pender, Perimans, Sampson, Stokes, Tyrrell, Watauga, and Yadkin. Of these counties the following reported a production in 1903: Martin, Pender, Sampson, and Stokes. There was only one county which made a production in 1904 that did not produce in 1903, and that was Richmond.

Of the 76 counties reporting a mineral production for 1904, there were only 48 counties that reported anything besides clay products. There were 57 counties reporting a production of clay, of which 27 counties did not report any other production. There were 14 counties reporting a mineral production which did not include any clay products. The number of counties producing both clay and other mineral products was 74. The county reporting the greatest value for mineral production, excepting clay products, was Rowan County, the value being \$127,774. The county producing the greatest value of clay products was Guilford, the value being \$189,718. The county whose total mineral production was greatest in value in 1904 was Guilford County, the value being \$202,617. Rowan County is second in the value of its total mineral production, which was valued at \$150,774. The lowest value reported by any county for its mineral production was Alexander County, with a value of \$150.

PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building Stone in North Carolina, by Joseph A. Holmes, George P. Merrill and T. L. Watson. *In preparation.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Out of print.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Out of print.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Out of print.*
8. Water powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesians Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
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15. Mineral Waters of North Carolina, by F. P. Venable. *In preparation.*
16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*
17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*
18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1904. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS.

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina during 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina during 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

7. Mining Industry in North Carolina during 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina during 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

9. The Mining Industry in North Carolina during 1904, by Joseph Hyde Pratt, 1905. 8°, 96 pp. *Postage 4 cents.*

REPORTS.

Vol. 1. Corundum and the Peridotites in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis. 464 pp., 35 figs.; 45 pls.; 1 map. *Express collect.*

Vol. 2. Fish and Fisheries in North Carolina, by H. M. Smith. *In preparation.*

Vol. 3. Building Stones of North Carolina, by G. P. Merrill, F. B. Laney and T. L. Watson. *In preparation.*

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